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A SURVEY OF AIR FORCE COMPUTER-BASED TRAINING (CBT) PLANNING, SELECTION, AND IMPLEMENTATION ISSUES

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The purpose of this research was to investigate the procedures, issues and problems associated with the development and use of computer-based training by the Air Force. Aspects of computer-based training investigated include the planning of projects, project management to include personnel management, computer-based training development procedures and the effective use of computer-based training. A nonrandom sample of Air Force computer-based training experts (N = 253) from 51 organizations completed an extensive questionnaire, answering questions about the planning, selection, development, validation, implementation and maintenance of Air Force developed computer-based training. A subsample of that group was interviewed to clarify questionnaire responses and to obtain anecdotal information. Results indicated the procedures, issues and problems associated with computer-based training. Recommendations to improve procedures and solve issues or problems are provided based on the study results.

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PREFACE

This work was undertaken by Mei Associates, Inc. on behalf of the Armstrong Laboratory, Human Resources Directorate (AL/HR) as part of a larger study of Air Force computer-based training (CBT). This report presents the findings of the Laboratory in its survey of Air Force CBT users.

This project benefitted from the many helpful suggestions from Dr. Scott Newcomb, Chief, Instructional Design Branch, and Armstrong Laboratory Scientists Captain William Dimitroff and Mr. Dennis Gettman. In addition to their significant input regarding the data collection instrument, interview techniques, and data analysis procedures, each of these scientists helped the authors focus their attention on matters of importance to the Air Force. Mr. Gettman also contacted numerous Air Force organizations *suspected* of using CBT, so that they might be included in the survey and accompanied the research team to several bases to facilitate collection of the data.

Special thanks are in order to Dr. Juanita Firestone of the University of Texas at San Antonio, who provided valuable assistance to the authors in survey methodology. Dr. Firestone focused attention on what could be done and how to do it properly. Her fine attention to the details of statistical analysis helped improve the findings of the survey. Dr. Firestone was instrumental in guiding the research team through the development of the research plan. Her guidance helped the researchers determine what analytical and statistical techniques could and should be used in analyzing the data. Once data were coded, she constantly provided suggestions as to what analytical procedures might yield the most interesting results. Her review of the findings helped eliminate any inconsistencies which might otherwise have been there. The research team was also aided by Robert "Les" Caldwell, who manipulated the SPSS database with diligence, and provided the insight of an outside observer to CBT data. Ms. Diann K. Andy was also helpful by applying her practical, computer-based training expertise to the development of the questionnaire. Diann spent numerous hours recalling potential problem areas she had witnessed first-hand, and formulating these into questions which could objectively categorize the various aspects of CBT issues.

SUMMARY

Computer-based training (CBT) is widely used by the Air Force to conduct training. Numerous CBT technologies are being employed by Air Force organizations worldwide as tools for training new skills, upgrading or refreshing existing skills, and to maintain currency of personnel in their jobs. Some of the CBT being used has been developed by contractors, but much of the courseware has been developed *in-house* by various Air Force organizations. This survey conducted under the auspices of Armstrong Laboratory examined the procedures used by the Air Force in developing CBT *in-house*. The ultimate goal of the research is to provide suggestions to improve Air Force CBT.

The survey sample consisted of 253 participants from 14 Air Force commands and operating agencies at 26 bases and 51 organizations. The participants were 70 officers, 117 enlisted and 66 civilians involved in CBT as managers, instructors, developers or computer systems experts.

Several major issues were investigated regarding planning for CBT, selecting a CBT system, developing CBT courseware, and implementing CBT, including :

- o CBT Planning
- o Management of CBT Programs
- o CBT Development Personnel
- o Effective Use of CBT
- o CBT Development Procedures

Many Air Force organizations are hard at work implementing CBT. The effort expended by numerous individuals and the pride in their accomplishment demonstrated to the research team are typical of their spirit to do the best with what they have. Although the findings of this survey concentrate on potential problems that these organizations face in developing CBT, one should not overlook the concerted efforts taking place throughout the Air Force to *make it work.*

CBT Planning

A majority of the respondents reported performing the various steps involved in planning for CBT; 77.6% performed a Training Needs Assessment, 67.1% conducted a Job/Task Analysis, 83.1% analyzed Trainee Characteristics, 64.1% assessed Facilities Requirements, 50% conducted a Media Analysis, and 86.9% developed Training Objectives. While these percentages indicate that many organizations are following accepted practices, some organizations are not conducting a complete front-end analysis for CBT. Many organizations surveyed appear to be using existing materials as the basis for CBT (59.4%). This has led to underutilization of the capabilities of the medium; 77.1% report that the media were *predetermined.*

CBT can be a costly medium. Many respondents reported that budgets did not accurately anticipate actual CBT costs (49.4%). Several sources of unexpected cost contributed to budget problems; 55.3% reported a longer than planned development time, 34.2% bought more

hardware than planned, and 28.9% bought more software than planned. When funding shortfalls occurred, projects were frequently either put on hold (41.4%) or reduced in scope (38.5%). Budget shortfalls also had an effect on individual lessons with 7.7% reporting they developed shorter lessons, 25.6% programmed fewer graphics, and 23.1% had less interactivity.

Management of CBT Programs

CBT managers are tasked to work with a complex medium with few guidance tools. A significant number of program managers (39%) had no CBT experience; 11.7% had neither experience nor training in CBT. Many respondents commented about CBT management during follow up interviews. While their comments tended to blame management for most problems involving scheduling and coordination of team efforts, survey data are supportive. Delays in the completion of project milestones indicate that CBT managers need specific guidance in what needs to be done and how to accomplish it. Respondents report storyboards were not completed on time (35.1%), on-line programming of lessons were delayed (44.4%), and implementation of CBT courses was delayed (28.2%). This survey identified several issues related to CBT management which need further research.

CBT Development Personnel

The experience profile of CBT development personnel is similar to that of managers; 52.6% of instructional developers and 53.9% of subject matter experts were inexperienced. Many development personnel had neither experience nor training (23.1% of instructional developers; 27.5% of subject matter experts). In addition to inexperience, personnel turnover over the life of a project was 26.6%. The most significant result of turnover was increased development time (72.1%). This complicated management problems.

Effective Use of CBT

Respondents made use of many CBT features such as graphics (95.2%), audio (48.2%), and video (45.4%), but specific applications tend to reflect that they were converting existing training to CBT. Factors considered in selecting CBT system hardware and software reinforce this. Training requirements were considered by 50.6% of respondents when selecting hardware and by 36.6% when selecting software. In contrast, far more respondents considered software requirements (72.3%) when selecting hardware, and hardware requirements (67.7%) when selecting software. 72.5% of respondents reported using the computer for management functions (CMI). CMI was reported as a factor in software selection by 53.8% of respondents. The inexperience of the development team affects the underutilization of CMI capabilities.

CBT Development Procedures

CBT courseware review procedures appear to be somewhat inefficient, in that major revisions are made late in the development process. Although developers made extensive use of such standardization aids as format guides (77.3%), sample lessons (52.1%), flowcharts (77%) and storyboards (83.2%), significant revisions are made even after lessons are already on-line (55.1%). Although 93.1% of respondents reported that courses were successfully validated, only

28.9% attempted to relate the training to job performance or made use of supervisor evaluations (18.4%).

Recommendations

While the findings from this survey are not conclusive, they are indicative that Air Force CBT is in need of improvement. Three specific courses of action to improve CBT are recommended based on the findings of this survey:

- Further research is needed on the *quality* of Air Force CBT. This survey did not examine the quality of Air Force CBT; instead it focused on issues of CBT planning, selection and implementation. Further research is needed to determine the effect that current CBT development practices have on the quality of Air Force CBT, i.e., its effectiveness and efficiency as a training medium.

- Specific guidance and training is needed for managers and developers of CBT. Data from this survey suggest several problems associated with CBT development. Those involved in CBT should receive clear guidance and also be provided training which not only addresses the steps to follow in CBT development, but also stresses the rationale for each step, how to do it, typical problems which might be encountered, and provides the managers and developers with an opportunity to practice their skills before being immersed into the job of developing CBT.

- Air Force personnel capable of developing CBT need to be identified for future assignments. If the Air Force intends to remain in the *CBT business*, a final recommendation to improve Air Force CBT is to provide a means within the personnel system to identify personnel with CBT skills for future assignment.

A SURVEY OF AIR FORCE COMPUTER-BASED TRAINING (CBT) PLANNING, SELECTION AND IMPLEMENTATION ISSUES

I. INTRODUCTION

The purpose of this study was to collect, document, and analyze data on problems associated with Computer-Based Training (CBT) planning, selection, and implementation in the Air Force. The term "CBT" in this report refers to all training technologies which utilize a personal computer as a centerpiece. This includes interactive video (IVD), digital video interactive (DVI), audio, and PC-based simulations. It also includes other acronyms for instructional uses of the computer, such as Computer-Assisted Instruction (CAI), Computer-Based Instruction (CBI), Computer-Assisted Learning (CAL), and Computer-Managed Instruction (CMI).

The use of CBT technology is becoming widespread throughout the Air Force. Various reports estimate there are approximately 50-100 new system "starts" annually. Indications are that the scope of CBT technology in the Air Force is currently quite extensive and is expanding every year.

When CBT technology has been properly planned for, and is implemented based on a sound plan, it can have a positive effect on both training effectiveness and efficiency (Kemner-Richardson, Lamos and West, 1984; MacNiven, 1987). However, when CBT is not properly planned for, when an inappropriate CBT system is selected, or when a CBT implementation encounters problems, the results can be just the opposite. When improperly applied, CBT can potentially result in ineffective instruction leading to substandard learning, or increased costs due to longer training times, courseware development problems, and logistics or maintenance problems. In addition, the inappropriate application of CBT in a training environment can result in adverse impacts on a training organization's operating structure, functioning and resources. Given the current state of planning for and selecting CBT systems, these problems do not manifest themselves until after a CBT system has been developed or implemented.

In determining the appropriate media application for their training environment, Air Force and other Department of Defense (DoD) users need to be able not only to select CBT from a group of other media alternatives, but also to select the most appropriate CBT system for their specific training needs. Planning for CBT technology is frequently the result of the technology driving the requirements, rather than using the requirements to specify the technology, as for example, when CBT technology, including hardware and software is acquired prior to the definition of user training requirements. This can result in the inappropriate use of the technology, i.e., forcing the requirements to match the available technology. The selection of CBT should be made so that the users get the most powerful system for training, while the Air Force has the benefit of a cost-effective solution.

This study documents the results of a CBT survey undertaken by Mei Associates for the Human Resources Directorate of Armstrong Laboratory (AL/HR). The survey was designed to gather information from Air Force personnel about who is doing CBT, how they are going about it, problems they are experiencing, and the consequences of those problems. This report will provide Air Force policy makers, administrators, and researchers, the evidence they need to begin improving the way the Air Force currently develops and implements CBT.

II. METHODS

One of the most difficult tasks in gathering information about CBT problems is getting people to admit that problems exist. A unique feature of this study is that the researchers avoided asking participants about particular problems. Instead, every attempt was made to find out about the *procedures* used and the *consequences* of those procedures. This strategy facilitated obtaining an objective response, and provided the data needed to make inferences about current problems. If a participant mentioned a specific problem, the researchers noted it; however, researchers avoided priming participants or asking directly about potential problems.

Sample

Participants in this study were Air Force military and civilian training personnel directly involved in CBT planning, selection, or implementation. The sample included program managers, contract managers, developers, instructors, and programmers.

Because CBT is a relatively new training medium, there is no comprehensive list of Air Force organizations involved in CBT development. The population has never been identified and statistically characterized. For this reason, it was impossible to select a random sample for this study. Instead, a nonrandom sample was used in which participants were selected on the basis of their membership in the population and their availability to participate.

Subjects

There were 253 participants in the study, of which 245 completed some portion of the CBT survey.[1] Of the 253 participants the researchers conducted follow-up interviews with 103.

Participants by Command

The participants represented 14 commands and special operating agencies, 26 bases, and 51 different organizations (i.e., wings, groups, or offices). The major commands and special operating agencies represented in the study are listed below, in decreasing order of the number of respondents from each. Figure 1 shows the number of participants from each command.

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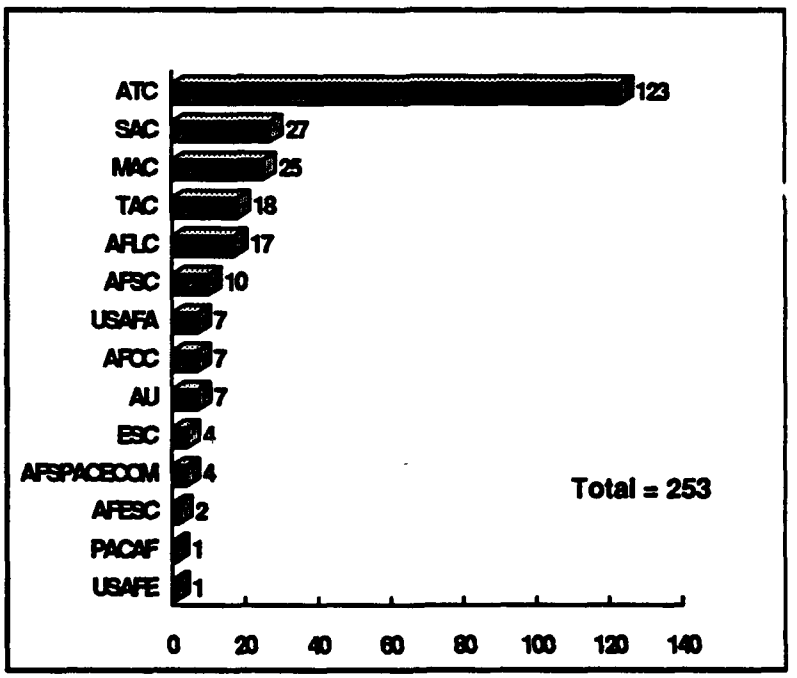
[1] Of the 253 personnel contacted one participant failed to turn in the survey questionnaire because it was lost. However, the participant still provided data during the interview portion of the survey. Seven other participants completed the Personnel Profile Questionnaire but did not answer any survey questions.

- Air Training Command (ATC)
- Strategic Air Command (SAC)
- Military Airlift Command (MAC)
- Tactical Air Command (TAC)
- Air Force Logistics Command (AFLC)
- Air Force Systems Command (AFSC)
- U.S. Air Force Academy (USAFA)
- Air Force Communications Command (AFCC)
- Air University (AU)
- Electronic Security Command (ESC)
- Air Force Space Command (AFSPACECOM)
- Air Force Engineering and Services Center (AFESC)
- Pacific Air Forces (PACAF)
- U.S. Air Forces in Europe (USAFE)

Figure 1. Number of Study Participants by Command



The number of respondents per command range from one (at PACAF and USAFE) to 123 (at ATC). However, this graph should not be interpreted as representing the actual number of personnel who work with CBT within each command; rather, it depicts those commands from which study participants were drawn, and the extent to which the various commands were represented. The focus in selecting participants was on their availability and experience using some form of CBT technology.

Participants by Rank

There were 117 enlisted participants (ranging from Airman to Chief Master Sergeant), 70 officers (ranging from Second Lieutenant to Colonel), and 66 civilians (ranging from GS-5 to GM-14). Table 1 provides an exact breakdown of participants by each rank or grade.

Participants' CBT Experience

The level of CBT experience of the participants ranged from 1 to 150 months. Most participants had about 20 months of experience using CBT. Survey participants were also asked to report the amount of CBT experience they had in particular job categories. These job categories were:

- o Manager of CBT program
- o Developer of CBT courseware
- o Instructor in CBT course
- o CBT contract monitor
- o Staff computer systems expert involved in CBT

Table 1. Ranks/Grades of Respondents

Enlisted		Officer		Civilian	
Rank	Number	Rank	Number	Rank	Number
Airman	1	2Lt.	2	GS-5	1
Sgt.	4	1Lt.	6	GS-7	1
SSgt.	42	Capt.	28	GS-8	1
TSgt.	42	Major	21	GS-9	12
MSgt.	19	Lt. Col.	12	GS-10	2
SMSgt.	8	Col.	1	GS-11	16
CMSgt.	1			GS-12	22
				GS-13	2
				GM-13	6
				GM-14	3
TOTAL:	117		70		66

Note. Data from Personnel Profile Questionnaire.

Table 2 shows respondents' average months of experience at these job positions by command. In general, staff computer systems experts had the most experience with 33.5 months. Program managers, contract managers and developers each had approximately the same amount of experience (about 2 years). CBT Instructors were the least experienced participants with 19.1 months.

Table 2. Average Experience Levels of Respondents by Command and Job Category[a]

Command	Manager	Developer	Instructor	Contract Monitor	Systems Expert
All	26.5 (120)[b]	24.0 (163)	19.1 (53)	24.9 (55)	33.5 (57)
ATC	28.1 (51)	26.4 (83)	18.3 (36)	20.8 (21)	39.5 (30)
TAC	28.1 (12)	26.5 (12)	---	27.9 (12)	36.3 (3)
SAC	20.5 (22)	27.4 (18)	26.3 (7)	17.4 (8)	30.2 (6)
MAC	24.4 (13)	16.4 (14)	15.0 (2)	29.5 (6)	19.3 (6)
Others[c]	29.4 (22)	18.7 (36)	17.6 (8)	15.5 (8)	26.5 (12)

--- No respondents in this category.

a Values given = months spent in the given job. Data from Personnel Profile Questionnaire.

b Values in parentheses are the total number of respondents to the question regarding months experience for the given job category. Many respondents were holding or had held more than one type of position.

c "Others" category includes USAFA, AFSPACECOM, AFCC, AFLC, AFSC, ESC, USAFE, AU, and AFESC.

Survey Development

The survey was designed and structured so that groups of questions were answered only by personnel who had the required background knowledge. Branching questions were used extensively to route respondents around sections of the questionnaire and specific questions they were not qualified to answer. For example, at the beginning of each major section of the survey -- Planning, Selection, Development, Validation, Implementation, and Maintenance -- participants were asked if they had been involved in that activity; if they had no experience, they were branched to the next section. This feature enabled the long questionnaire to be completed within a reasonable time (approximately one hour) by most participants. Another feature of the survey which helped shorten the response time was that questions about various CBT procedures such as listing of system components or giving reasons or causes for something happening were presented in checklist form. This design allowed respondents to simply check off the responses that described their situation and enabled the researchers to easily collect detailed data. Figure 2 depicts a set of typical branching questions; a complete copy of the survey instrument can be found in the Appendix.

Figure 2. Sample Survey Questions

9. Was a formal job/task analysis performed as part of the CBT planning process?

Yes No

10. If 9 = No, why not? (Check the appropriate response/s.)

___ There wasn't enough time.
___ There were not enough funds.
___ Personnel were not available to conduct the analysis.
___ Personnel (subject matter experts, etc.) were not available to provide the data necessary to complete the analysis.
___ Jobs and tasks were derived from current course material and/or manuals.
___ The job/task analysis completed previously was current.
___ Other: _____

The development of such an extensive survey required information from various sources. The research team reviewed a broad spectrum of literature on CBT planning, selection of CBT systems, CBT development, implementation and validation procedures, and the maintenance of CBT courseware and systems (e.g., Gery, 1987; Alessi and Trollip, 1985; Kearsley, 1987; Schlecter, Burnside and Thomas, 1987). In addition to the literature review, the members of the research team used their own experiences in CBT as a starting point for development of the questionnaire. Armstrong Laboratory scientists commented on initial draft versions of the questionnaire and arranged for a tryout of the instrument and data collection procedures with a nearby command using CBT. This earlier version of the questionnaire consisted of 198 questions divided into five sections: Planning, Selection, Development, Validation, and Implementation. It was administered to 47 subjects. The second version was restructured slightly and included additional questions to cover potential problem areas not fully addressed in the initial version (such as courseware maintenance). Otherwise, questions on the two versions were similar. The revised version consisted of 226 questions divided over six sections (including a new section on Maintenance), and was administered to 206 subjects. Both versions also contained a Personnel Profile section for demographic data and a Discussion section, to cover respondents' areas of concern or interest which had not been addressed by the questions. For analysis, data from the two versions of the questionnaire were combined.

Branching

Sample size varied among many survey questions as reflected by differences between values of *n* in Figures, Tables and the Appendix. This is due to the questionnaire's branching structure that channeled respondents to appropriate questions based on individuals' qualifications

and experience. In addition, a few respondents simply skipped some questions. The percentages represent the number of respondents who chose a question option compared to the number of individuals eligible to respond (i.e., adjusted for branching and skipped answers).

Figure 2, for example, shows a typical survey branching question. These data are from survey questions 9 and 10. A total of 47 respondents answering *No* to question 9 were eligible to answer question 10. However, the option *The job/task analysis completed previously was current.* did not appear on the earlier version of the questionnaire, therefore fewer respondents (38) were eligible to select it. The actual distribution of percentages for these questions can be seen in Figure 4 in the Results section of this report.

Survey Procedures

Data Gathering

After the survey design was completed and approved by the Armstrong Laboratory, it was necessary to identify participants; this was primarily the responsibility of the Laboratory scientists. A comprehensive list of Air Force individuals and groups involved with CBT was not available. Therefore, the Laboratory scientists with the cooperation of major command points of contact (POC) identified and initially contacted potential study participants using snowball sampling techniques. Organizations developing CBT *in-house* were of particular interest. Potential participants were contacted and survey participation set up as the Laboratory learned about them. Once an organization fitting the profile was identified, Laboratory scientists designated a POC at the site and determined the number of individuals who would participate in the study. The researchers sent surveys to the POC at the site, who was in charge of their distribution and return. This approach resulted in a 96.8% response rate for the survey.

During early phases of data collection the researchers visited each base that participated in the survey. As trends in responses to interview questions were established, i.e., respondents were discussing the same matters over and over, visits were restricted to those organizations which were different from the ones previously visited in terms of type of CBT system, major command, or other characteristics. Questionnaires were mailed back to the researchers, who reviewed them and identified participants for follow-up interviews to clarify responses. Sometimes follow-up interviews were scheduled because of the extensive CBT experience of some respondents. The feeling was that the more experience a respondent had, the better he or she would be able to describe what was going on in Air Force CBT. In some cases, Laboratory scientists accompanied the research team on site visits. Armstrong Laboratory personnel did not participate in the interviews. The researchers sought to eliminate any potential influence by another Air Force individual during the survey so that the responses (especially during the interview) were those of the respondent alone, not necessarily *official policy*.

Setting Up the Database

SPSS/PC (version 4.0) was used for statistical analysis. The coding strategy assigned a variable for each possible response to each question. Each variable was coded as "0" for *No*, "1" for *Yes*, "8" if a question was skipped because the respondent had been branched around it, and

"9" if a question was skipped because the respondent chose not to answer it or misinterpreted directions.

Several survey questions were designed to have multiple responses. For these questions, each response was designated as a unique variable. Thus, data from the questionnaire, which contained 226 questions, were coded as 928 separate variables. The data matrix (n x the number of variables) was 245 x 928.

Data Preparation

Some respondents did not answer the survey questions as directed. For example, for questions where a *Yes* or *No* response was called for, some respondents circled both. In other cases, respondents would simply skip questions, either because they misinterpreted instructions or because they did not wish to respond. Before the survey data were entered into the database, these unexpected responses had to be reconciled so that each variable for every respondent had only a single recorded response.

Rules were devised to systematize the reconciliation process. For example, in cases where a participant circled both *Yes* and *No*, the response which was more indicative of a problem was coded. Or, in cases where circling *Yes* or *No* allowed the respondent to branch around a set of questions, but follow-up questions were answered anyway, the response to the original question was changed to be consistent with their answering the follow-up questions. Reconciling the data involved checking each survey individually for accuracy, coding skipped questions where required, and verifying inconsistent responses.

During the reconciliation process, steps were taken to insure compatibility between responses from the initial and final versions of the survey. In cases where questions existed on one version but not on the other, the corresponding variables were coded as "8" -- *skipped* for all cases where the question was not included. This allowed the researchers to work with a single consolidated database of information from both versions.

Data Analysis

Data analysis focused on providing descriptive data and comparing relationships at the aggregate respondent level. For issues of special interest, data were collapsed and assessed for specific demographic groups such as major commands and various experience levels.

Analyses were conducted in two stages due to the large amount of data collected and the size of the data matrix.

Stage 1. Descriptive statistics were run during the initial analysis. These included computing frequencies, means, medians, and modes, depending on the level of measurement. These statistics provided a description of the data, an assessment of relationships between key variables, and a reduced data set. Results from this analysis were used for three primary purposes: 1) to provide a preliminary description of the data; 2) to identify issues for further analysis; and, 3) to eliminate variables with too few respondents to provide useful information.

Stage 2. The second stage of analysis involved creating cross-classification tables, both simple and elaborated, using the reduced variable set from Stage 1 to provide a more detailed analysis of relationships between variables.

Handling of *Other* Responses

The checklist structure of this survey ensured that much of the information queried was already in the text of the questions. Participants could simply check applicable responses. However, in case participants wished to add their own responses, all checklist questions contained an *Other* option where respondents could record any relevant information which was not already listed. During the data entry phase of the study, *Other* responses were recorded in the database. After frequencies were computed, *Other* responses to a given question were examined if more than 30% of respondents had indicated one for that question. If several subjects mentioned the same type of information, the trend was investigated.

Qualitative Data

Numerous qualitative data were gathered from the Discussion section of the survey and from the interviews. To reduce these data to a more manageable form, information was categorized into problem areas. A separate coding scheme was developed for each and tested for reliability using *phi*. The inter-rater reliability was .70 for the Discussion section, and .46 for the interviews.

III. RESULTS

The researchers' goal was to conduct a survey of Air Force organizations involved in developing and implementing CBT in order to reveal any problems that should be corrected, and successful practices which could be modeled by other organizations. This chapter describes nine CBT issues. In the following sections, each issue will be identified and explained:

- CBT planning procedures
- Management of CBT
- Preparation of CBT development personnel
- Effective use of CBT
- Efficiency of the CBT development process
- Standardization
- Validation
- Implementation
- Maintenance

CBT Planning Procedures

Planning is a critical function in all CBT development efforts (Andrews and Trainor, 1987). It cannot be overemphasized that proper planning can and will eliminate many problems

encountered later in a CBT program. The elements of planning for CBT are similar to planning for any other successful venture (Carter, 1991; Kemner-Richardson, Lamos and West, 1984). First, the organization must make sure that CBT is the appropriate instructional medium for their training requirements (i.e., they need to conduct some kind of media analysis). Second, the required resources (people, equipment, money, facilities, students, etc.) must be budgeted for realistically. Finally, the managers of the CBT effort must make sure that the people who will actually be developing CBT courseware, and implementing the CBT system are properly equipped to do their jobs. That is, courseware developers need to have up-to-date and complete course development materials available (such as relevant data on job/task analyses, trainee characteristics, training needs assessment, and training objectives). In addition, facilities need to be prepared to house the planned computer hardware in the desired configuration, and the staff who will be operating the CBT system must be prepared for its integration into the training environment.

Although planning is important to developing CBT on time and implementing it effectively, our findings show that the Air Force lacks specific policy or guidelines for CBT planning. Currently, CBT planners must rely on the policy which they can extract from the Instructional Systems Development (ISD) process. Although the ISD process can be successfully adapted to any instructional medium, there are peculiarities unique to CBT which make planning for it different from traditional training planning. These peculiarities include the need to purchase, become familiar with, and install large quantities of new and expensive equipment, the preparation of faculty and staff for their roles in a CBT classroom, and predetermining specific details of CBT lesson content to facilitate courseware development.

Several of the major planning steps of the ISD process were investigated. Table 3 shows the results for those respondents whose organizations performed each planning step. Few respondents (27.4%) reported their organization completed all six steps. However, almost half (48.9%) reported that their organization completed at least five steps with the most commonly omitted step being Media Analysis, a critical factor in CBT planning. This survey focused on assessing organizations' performance on seven important issues in CBT planning:

- Training Needs Assessment
- Job/Task Analysis
- Analysis of Trainee Characteristics
- Assessment of Facility Requirements
- Media Analysis
- Development of Training Objectives
- Budgeting

This report will show why each of these issues is important for CBT planning, and how these issues are being addressed by Air Force organizations.

Table 3. Performance of CBT Planning Steps by Command[a]

Command	Training Needs Assessment	Job/Task Analysis	Analysis of Trainee Characteristics	Facilities Requirements	Media Analysis	Training Objectives
All (n=144)[b]	77.6	67.1	83.1	64.1	50.0	86.9
ATC (n=60)	78.0	67.8	81.7	76.3	56.1	85.0
TAC (n=11)	90.9	81.8	55.6	60.0	70.0	90.9
SAC (n=14)	85.7	71.4	92.9	57.1	28.6	85.7
MAC (n=16)	75.0	56.3	87.5	56.3	31.3	87.5
Others[c] (n=43)	72.1	66.7	86.0	53.5	51.2	90.7

a Percentage of respondents who performed the given step. Data from survey questions 4,9,14,18, 22, 25 and Personnel Profile Questionnaire.

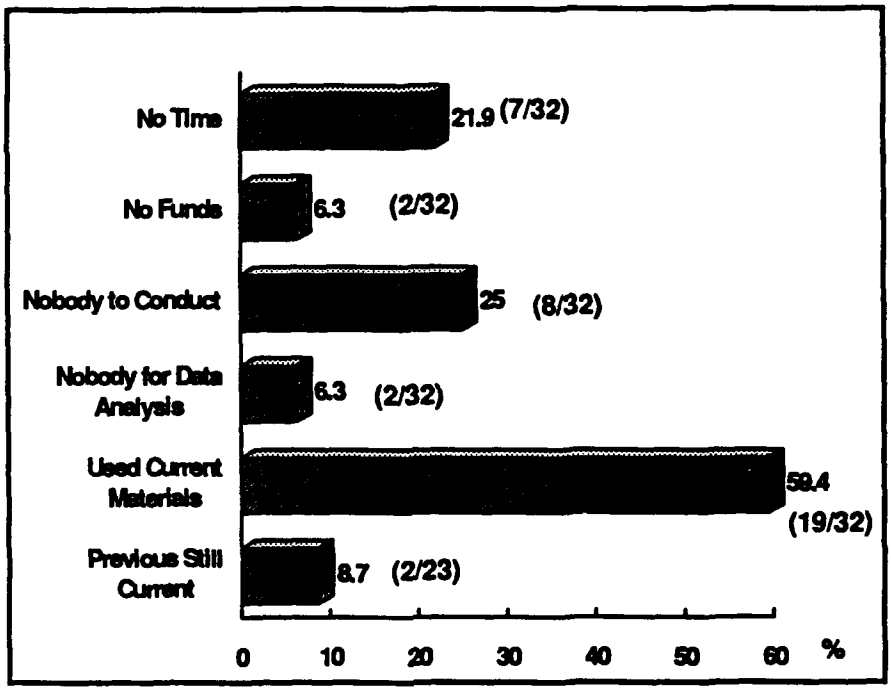
b Numbers in parentheses = number of respondents from the command.

c "Others" category includes USAFA, AFSPACECOM, AFCC, AFLC, AFSC, ESC, USAFE, AU, and AFESC.

Training Needs Assessment

Training Needs Assessment is normally performed when an organization suspects some discrepancy between what is being trained and what should be trained (Kaufman and Thiagarajan, 1987). A large number of respondents (77.6%) indicated that their organizations performed Training Needs Assessment. This number is surprising in light of the reasons given for not performing such an assessment. Figure 3 lists reasons why a Training Needs Assessment was not conducted. The majority of respondents (59.4%) indicated that they used current data or that a previous Training Needs Assessment was current (8.7%). This implies that CBT was part of a media upgrade for the training system, but the low number reporting Media Analysis (50%) is contradictory. Other respondents indicated that personnel were not available to conduct the study, no funds were available, and/or there was not enough time to conduct the study.

Figure 3. Reasons Why Training Needs Assessment Not Performed[2]



Note. Expressed as percentages of respondents citing the reason given for not performing a Training Needs Assessment. Data from survey questions 4 & 5.

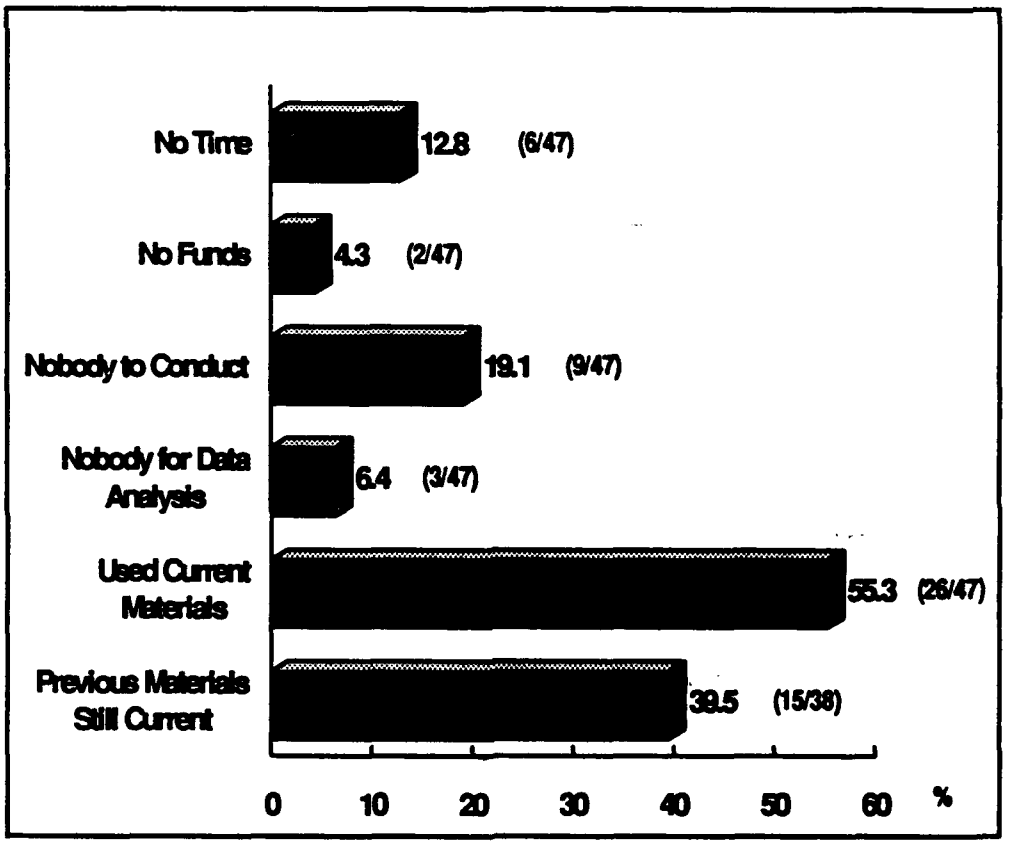
Job/Task Analysis

Instructional designers agree that the foundation for quality instruction is laid by a good Job/Task Analysis (Merrill, 1987). Job/Task Analysis normally involves listing all job tasks, equipment or materials involved with each task, the conditions under which tasks are performed, and the standards of performance which must be met. This material constitutes a formal description of what the trainee will ultimately be required to do on-the-job. The principles of ISD expressed in AFM 50-2 state, "To know precisely what instruction is needed, you must first know what tasks and knowledges make up the job." However, Table 3 shows that 32.9% of respondents did not perform a Job/Task Analysis. The respondents cited various reasons for not conducting such an analysis (Figure 4). The most commonly cited reason was that current course materials were used (55.3%); similar reasons were given for not performing a Training Needs Assessment (59.4%). This approach might be acceptable if the training requirements have not changed. However, only 39.5% of those who did not perform a Job/Task Analysis said that it was because previous materials were current. If such a high percentage of respondents reported that materials were not current, and no Job/Task Analysis was performed, one might speculate as

[2] Whenever there are differences in n due to branching or an earlier version of the questionnaire, the number of respondents who answered the item versus the total number of respondents eligible to answer the question is listed next to the bar. For a full explanation see Branching in the Methodology section of the report.

to whether or not the CBT being developed matches the job requirements. Other reasons given for not performing a formal Job/Task Analysis include not having enough personnel to collect or analyze the data. This theme reappears throughout other findings in this report. Lack of personnel or not being able to maintain a CBT team appears to be common in Air Force CBT projects and can adversely affect the CBT effort. Air Force CBT personnel may not be aware that Job/Task Analysis is a critical component of any training development effort.

Figure 4. Reasons Why Formal Job/Task Analysis Not Performed



Note. Expressed as percentages of respondents who did not perform a Job/Task Analysis. Data from survey questions 9 & 10.

Analysis of Trainee Characteristics

A large number of respondents (83.1%) indicated that their organizations analyzed trainee characteristics.[3] This analysis usually involves determining the skills, knowledge, abilities, and attitudes of prospective students and is used with Job/Task Analysis data to determine what needs to be taught, i.e., the difference between what is required and what is already known (Dick and Carey, 1985). It can also be used to determine if using certain

[3] Data from survey question 14.

instructional strategies or media would be effective. As part of CBT planning, it is a small, but significant contribution to the decision-making process.

Facility Requirements Assessment

Survey data indicate training personnel do not always assess facility requirements for CBT.[4] They frequently assume that existing facilities will be sufficient, the computer equipment may already be in place or else can be installed anywhere (the latter is often true when microcomputers are used). These assumptions can cause problems later when it turns out that changes are required, i.e., where facilities are insufficient, existing equipment cannot be used, or existing equipment is incompatible with the courseware. In general, it is far more efficient to identify facility requirements at the beginning of a project and to plan accordingly, than to be confronted with delays later.

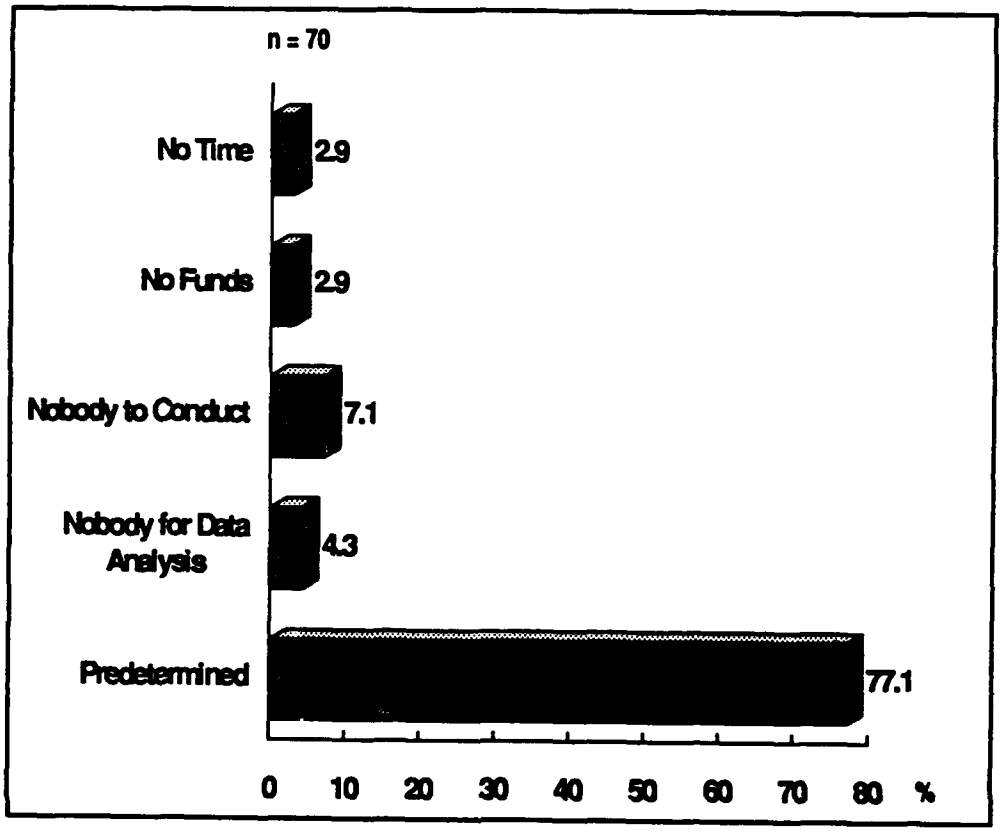
Various reasons were cited for why a Facilities Requirements Assessment was not performed. Some respondents indicated that because they were already using microcomputers such an assessment was unnecessary (15.4%). Others indicated that it was generally unnecessary (13.5%) or that personnel were not available to conduct the planning (13.5%) or provide the data (11.5%) or else money (9.6%) or time (9.6%) was not available. Over 44% of respondents stated the organization *could not* conduct the assessment. This is interesting because respondents recognized the need to perform such an assessment, although their organizations were unable to complete the CBT planning step.

Media Analysis

As part of CBT planning, Media Analysis is the least frequently performed step (50%). Media Analysis usually involves determining what types of instructional media would be most appropriate for delivery of training (AFP 50-58, Vol. IV; Gagné and Briggs, 1979; Dick and Carey, 1985). Often more than one medium can be used. Ideally, the decision should be based on which medium or media mix best meets training requirements. Other factors such as cost-effectiveness may also affect the decision. CBT may be selected because of its ability to provide interactive, self-paced instruction to students, to present sophisticated graphics or animation, or any of its other special media characteristics. Reasons *not* to select CBT may include its high initial cost, frequently changing instructional objectives, infrequent delivery, or the small size of the group to be trained. Some kind of media analysis would prove beneficial because of the large investment of personnel, time and money required to produce CBT.

[4] 64.1% reported that facilities requirements are assessed. See Table 3.

Figure 5. Reasons Why Media Analysis Not Performed



Note. Expressed as percentages of respondents who did not perform a media analysis. Data from survey questions 22 & 23.

Of the respondents who indicated that Media Analysis was not performed, Figure 6 shows the overwhelming reason (77.1%) was that media were *predetermined* by a higher authority. This raises the questions: Who predetermined it? What was the decision based on? Was a better, or cheaper alternative considered? Were any alternatives considered? As stated earlier, the Air Force has few guidelines for CBT planning and selection. It may be that there were reasons to select CBT that were not apparent to respondents. During the interviews conducted in connection with the survey, respondents' comments included: "Often CBT is used when some other medium would be more appropriate.". . . "The Air Force lacks a tool to determine when CBT is the proper medium.". . . "The CAI Handbook is not adequate for this purpose.". . . "CBT was selected because higher authorities wanted it." Overall, the data suggest either an incomplete understanding of CBT planning, or respondents were not aware of the context of prior decision-making.

Objectives Development

Nearly everyone responding to the survey (86.9%) reported that their organization developed objectives on which CBT was based. One would expect this to be the case, since the use of criterion-referenced objectives seems to be the one point on which there is little disagreement throughout most military training organizations. In those few instances where objectives were not developed, the overwhelming majority reported that it was because they made use of existing objectives (73.7%). Only one respondent reported that objectives were *not required.*

Budgeting

One result of the CBT planning phase is a program budget. Table 4 shows which Air Force personnel were involved in developing the CBT budget and their roles according to their reported job categories. Note that relatively few respondents from any job category provided data about facilities requirements or conducted cost-benefit analyses, two important CBT planning criteria. Based on the infrequent performance of facility requirements assessment (64.1%) and media analysis (50.0%),[5] it appears that these processes were not completely considered when formulating the CBT budget. Both of these planning steps can affect the budget. Problems associated with CBT installation such as rewiring a classroom, or moving lighting fixtures or electrical outlets may appear later. Such problems could be avoided by assessing the facilities requirements during CBT planning.

Cost-benefit analysis is the commonly accepted procedure for assessing alternative approaches to a problem. Cost-benefit analyses frequently raise questions early in a CBT program, and can be *show stoppers* if delayed until later stages of a program. Table 4 suggests that neither of these planning steps was given much attention by most of the respondents and that many of those involved in CBT planning may not be experienced, or may lack the proper guidance to follow in performing such analyses.

[5] See Table 3 for the percentages of respondents performing each planning step.

Table 4. Percentages of Job Categories Performing Various Budgeting Roles[a]

Budgeting Role	Program Manager (n=61)[b]	Contract Manager (n=18)	Instructional Developer (n=51)	Instructor (n=20)	SME (n=33)
Hardware Acquisition Input	83.6	77.8	82.4	90.0	87.9
Software Acquisition Input	93.4	83.3	92.2	90.0	90.9
Facilities Input	32.8	50.0	25.5	35.0	33.3
Personnel Requirements Input	70.5	72.2	72.5	70.0	75.8
Project Completion-Time Input	83.6	94.4	86.3	95.0	90.9
Team Training Requirements	65.6	61.1	68.6	65.0	63.6
Cost-Benefit Analyses	49.2	50.0	51.0	60.0	45.5
Development of the Budget	36.1	55.6	35.3	45.0	36.4

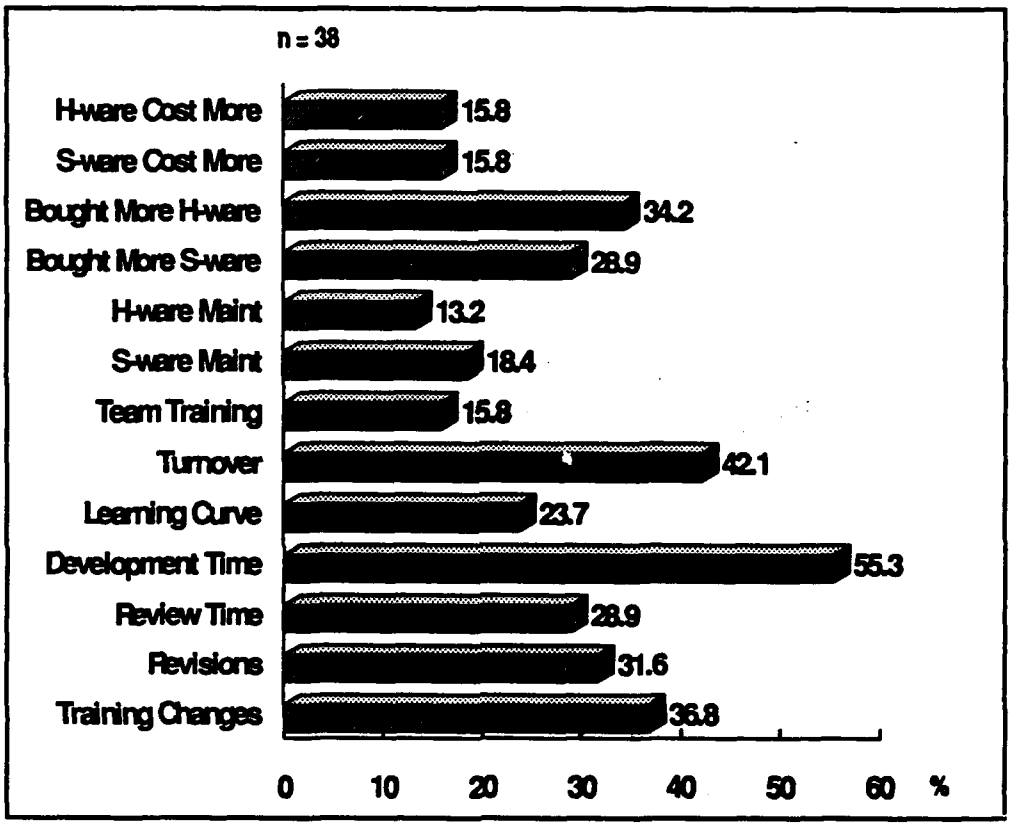
a Percentages of respondents with the given job title who performed a given role. It was possible for a respondent to fill multiple job positions and to perform multiple budgeting roles. Data from survey questions 2, 28 &29.

b Numbers in parentheses = number in the job category who reported involvement in budgeting.

One surprising result shown in Table 4 is the relatively high degree of involvement of instructors and SMEs in providing information about hardware and software. The researchers feel that the respondents may have meant that they gave advice regarding the type of hardware and software rather than actually developing the CBT budget for these items. Usually, those most familiar with the cost of computer systems would be expected to provide input regarding the costs of hardware and software. In Air Force CBT efforts anyone could be the source of this information including instructors and SMEs. However, the budget for a CBT program would best be developed by the program manager or contract manager.

In spite of the involvement of a wide variety of personnel in the CBT budgeting process, 49.4% of respondents said that the budget did not accurately anticipate costs.[6] Several problem areas were identified and clustered into three major categories: 1) cost estimates associated with hardware and software acquisition; 2) time allocated for various development functions; and 3) personnel turnover.

Figure 6. Sources of Unexpected Cost



Note. Expressed as percentages of respondents who indicated that the budget did not accurately anticipate costs. Data from survey questions 30 & 31.

Figure 6 displays a number of items related to unexpected costs. In the category of cost estimation six items[7] related to the acquisition of CBT hardware and software were associated with cost overruns. Initially, it seems that those organizations that underestimated the costs of hardware (15.8%) and software (15.8%) could have done a better job of predicting computer systems costs. However, when viewed together with the other related items, namely "bought more hardware" (34.2%), "bought more software" (28.9%), "underestimated hardware

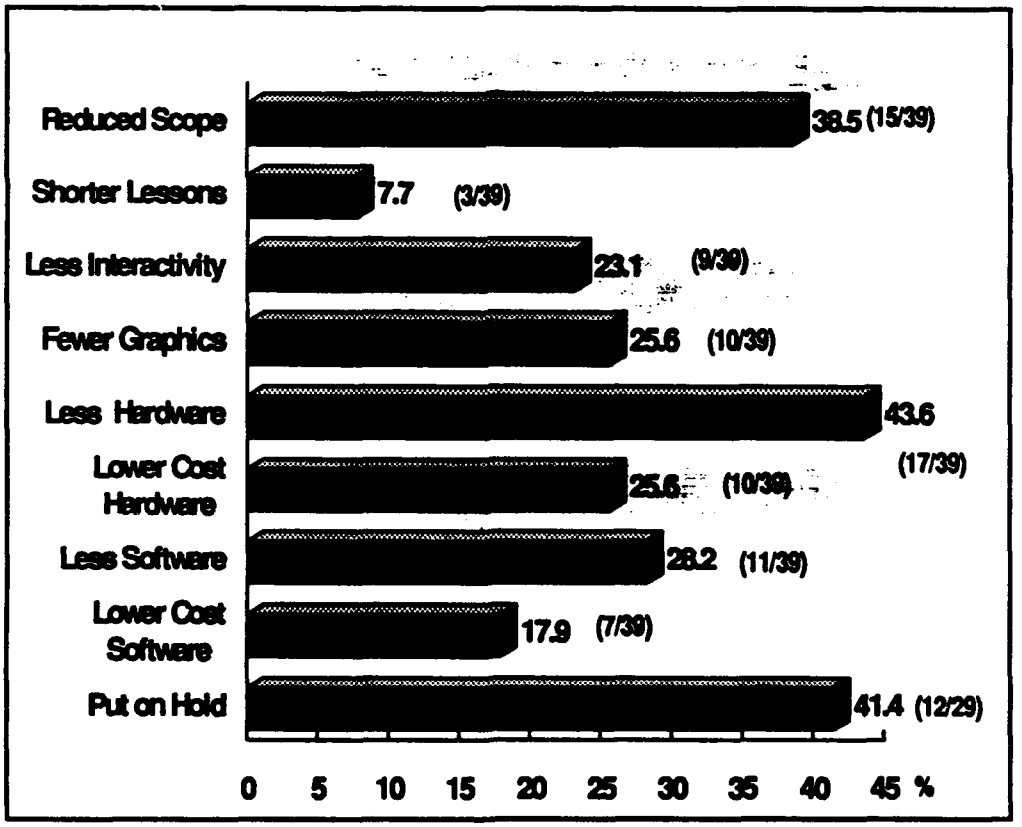
[6] Data from survey question 30.

[7] These are the first six items displayed in Figure 6.

maintenance costs" (13.2%) and "underestimated software maintenance costs" (18.4%), there appears to be no clear guidance for estimating costs.

There are also problems associated with developing CBT within the original time estimate. When asked whether the CBT budget accurately anticipated costs, respondents indicated that there were four sources of unexpected costs related to completing a project on time. Over half (55.3%) of the respondents indicated that CBT development took longer than expected. CBT review time was exceeded by 28.9% of the respondents, and revisions caused unexpected production delays (31.6%). These problems relate to the relative inexperience of the CBT development team and ineffective project planning (Jay, Bernstein and Gunderson, 1987). Perhaps the most significant item was that 36.8% of the respondents reported that the training requirements *changed*, causing courseware revisions. If this information is considered with the fact that only 67.1% of respondents reported completing a Job/Task Analysis (see Table 3), the effect of not properly defining the training requirements before starting CBT can be better appreciated.

Figure 7. Effects of Funding Shortfalls



Note. Expressed as percentages of respondents who indicated that funding shortfalls caused the given effect. Data from survey questions 32 & 33.

The third problem related to CBT budgeting was personnel turnover. Respondents reported that the cost of training CBT development team personnel (15.8%) was not factored into the original budget. In addition, 42.1% reported that additional training was required because of the turnover of team personnel. While the cost of training team personnel might not be a major expense in a CBT budget, it reflects personnel turnover that is associated with many Air Force CBT projects. Personnel turnover can seriously affect many aspects of a CBT project such as scheduling or causing additional revisions because of failure to adhere to established patterns and practices.

Poor estimation of CBT costs or simply the lack of availability of funds can have a serious impact on CBT projects. The survey investigated the results that funding shortfalls had on projects (Figure 7) and found three major consequences: 1) projects are put *on hold* (41.4%), 2) less equipment is purchased than originally estimated (43.6%), or 3) the scope of the effort is reduced (38.5%). Each alternative is an acceptable approach to accommodating funding shortfalls. However, there were three items reported which might negatively impact the quality of Air Force CBT lessons. Namely, these are the tendency to reduce the length of individual lessons (7.7%), a reduction of interactivity within the lessons (23.1%), and a reduction in the number of graphics used (25.6%). None of these alternatives is acceptable if it downgrades the training.

Summary of CBT Planning Procedures

In summary, Air Force CBT planning appears to be inconsistent. Planning steps are often omitted or are performed in a cursory fashion. The reasons given for why steps are not performed suggest that the basic problem is a lack of understanding of what CBT planning requires, rather than lack of resources for planning. The net effect of not completing CBT planning steps is that all subsequent processes are affected. Clear policy and usable CBT planning guidelines are needed. Air Force training personnel may not have the training and experience to know how to plan without additional assistance.

Management of CBT

Managing CBT development is different from managing development of other training media (MacNiven, 1987; Air Training Command, 1988). To begin with, CBT is a still emerging technology. In many cases, prospective CBT managers are not sure what is required for CBT development, or how to support the technology. Second, CBT development requires not only knowledge about the specific subject matter and training methods, but also familiarity with computer technology. CBT managers need to be willing to learn about and prepare themselves for this new technology.

The survey did not ask direct questions about management problems on the assumption that participants should not be placed in a position of having to respond to potentially sensitive issues. Surprisingly, however, respondents were free with their comments about management when given the opportunity to express themselves: 31.2% commented about management in the discussion section of the survey, and 66% did so during the follow-up interviews. These comments and indirect indications from the survey suggest that Air Force CBT managers are not

efficiently managing CBT projects, including, for example:

- o providing clear guidance,
- o coordinating development team efforts,
- o meeting deadlines, and
- o being familiar with CBT technology.

Guidance in CBT Development

One indicator that managers are not providing sufficient guidance to CBT developers is that lessons are frequently changed. One of the most frustrating situations for a courseware developer is to be told to do things one way one day, and another way the next. This is particularly a problem after a CBT lesson has been programmed because changes which affect graphics and branching can be extremely time-consuming to execute. However, major changes occurring late in CBT development are characteristic of most CBT efforts inside the Air Force. Respondents reported that even after lessons were on-line, changes were made to lesson objectives (17.6%), graphics (49.3%), sequence of instruction (40.1%), branching (48.6%), and lesson content (69.7%).[8] In addition, a number of interviewees made comments to the effect that "developers should not be subject to the whims of several reviewers," and that development took longer than expected because "supervisors kept making changes to lesson format and style." As one respondent remarked, "With no consistent directions from the top, and constant changes, no one is sure what's going on from day to day. What you're working on today may be cancelled tomorrow." These comments indicate that two-way communication of the immediate goals of CBT projects can be improved.

Another indicator that Air Force CBT developers' comments are representative is that CBT planning is not fully conducted prior to beginning some CBT projects. Proper planning provides the roadmap for everything that follows. If planning steps are omitted, then they will need to be made up for later in the project. For example, if objectives are not developed or are not current, then changes to lessons will be necessary at some point, perhaps as late as after a lesson fails validation. Or, if key personnel are not convinced via a media analysis that CBT is the appropriate medium there will always be uncertainty, which may translate into lack of support, regarding the wisdom of that choice.

It is difficult for CBT managers to provide sufficient guidance for CBT developers because relatively little guidance exists for the managers themselves. Additionally, there may be a tendency for managers and developers not to ask what is available. *ATC Pamphlet 50-4, The CAI Decision Handbook*, provides helpful guidance for managers. It appears that managers need more guidance about the roles and duties of CBT personnel, how to estimate cost and development time, and what effective CBT should look like. One manager noted in an interview, that he is required to know: "how long does it take to develop CBT courseware, ratio of development, timekeeping, record sharing, and additional duties." Another manager said, "Problem areas were not addressed by the guidance that currently exists, e.g., problems created by ignorance of CBT but adherence to authority (do it because I said so); who should run the

[8] These are discussed in greater detail in the section "Efficiency of CBT Development."

program; lack of regulatory guidance or parameters for CBT projects; lack of manpower formulas/standards and development times."

Some organizations have internal guidelines. For example, TAC has developed its own CBT format guide and the 3480 TCHTW at Goodfellow AFB has developed a CBT Style Guide. The Armstrong Laboratory has developed the *Guidelines for CBT Planning, Selection, and Implementation*, which will be published as volume 7 of *Air Force Pamphlet 50-68*, during the second quarter of FY92.

Coordination of Team Efforts

In most cases, CBT projects are team efforts bringing together personnel with diverse skills, such as instructional developers, subject matter experts, graphic artists, video experts, and programmers. Team members are often unfamiliar with CBT, or have not worked together before. A substantial proportion of survey participants indicated that team members were not aware of their roles and responsibilities (22.2%); a formal chain of authority did not exist within the CBT project team (21.4%); activities of each team member were not coordinated throughout the project (25.8%); and communication between each of the team members was not clear and effective (27.4%).[9] These data indicate that coordination of CBT was not always present at the team level and reinforce the notion that CBT managers would benefit from additional guidance or training.

Meeting Deadlines

Delays are commonplace in Air Force CBT development. Many respondents reported that there were delays in storyboard production (35.1%), on-line lesson production (44.4%), and implementation (28.2%).[10] These findings are likely manifestations of inadequate planning, personnel turnover, inexperience and insufficient training. More discussion of the reasons for delays will appear in the section "Efficiency of CBT Development Process."

Familiarity with CBT Technology

Many survey respondents said that their managers were not computer literate, were not aware of the benefits of CBT, and were resistant to new technology. As one remarked, "People in the higher decision-making positions don't really understand what's involved in the development of [CBT] projects. They have trouble understanding why it takes so long to develop a project." At the team level, program or contract managers need to evaluate the products produced during development, and to advise developers about how to produce better courseware. Ideally, these managers were once CBT developers themselves; if not, simply attending a brief course prior to beginning a project might be helpful, but appears to be insufficient to provide all the prerequisite knowledge that CBT managers need. Figure 8 displays the reported level of experience and/or training in CBT instructional design techniques for CBT program and contract managers. Large percentages of program managers (39%) and

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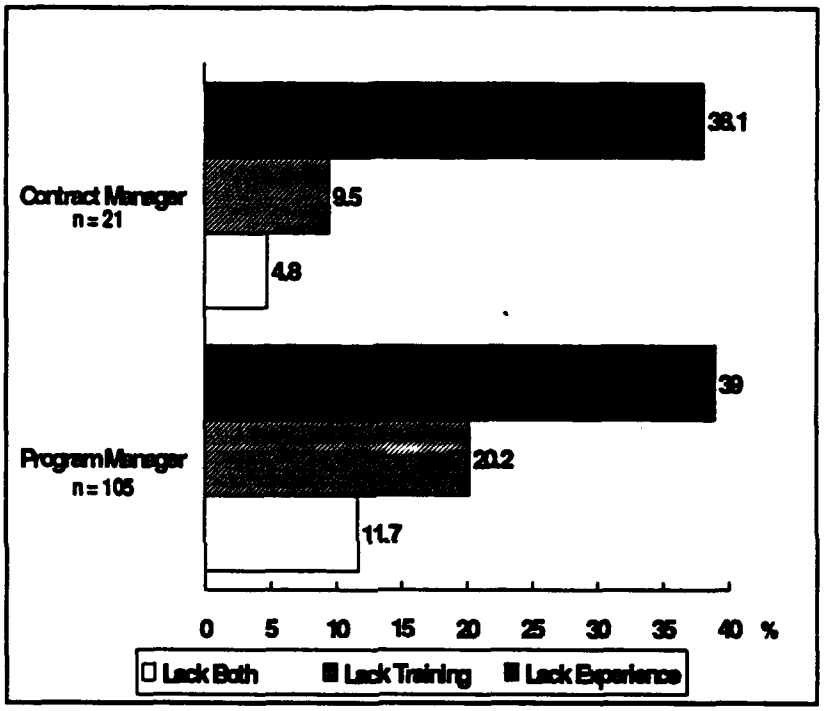
[9] Data from survey questions 59, 61, 63 & 64.

[10] Data from survey questions 115, 152 & 171.

contract managers (38.1%) lack practical CBT experience. Considerably smaller numbers of program managers (20.2%) and contract managers (9.5%) lack training and even smaller percentages of program managers (11.7%) and of contract managers (4.8%), lack both experience and training. According to development team members' comments, training is not adequate to prepare managers for CBT.

Figure 8. Managers Lacking CBT Experience, Training, or Both



Note. Expressed as percentages of respondents reporting that the given job categories on their development team lacked experience, lacked training, or lacked both. Data from survey questions 58, 65, 67, 68 & 70.

Summary

Some of the comments made by respondents blame management for problems in Air Force CBT programs. Other data in this survey reinforce their position. Specific causes of CBT management problems are addressed in this report, although our data cannot be used to investigate Air Force CBT management practices. Further research is required on management problems in order to improve the overall quality of CBT produced in-house.

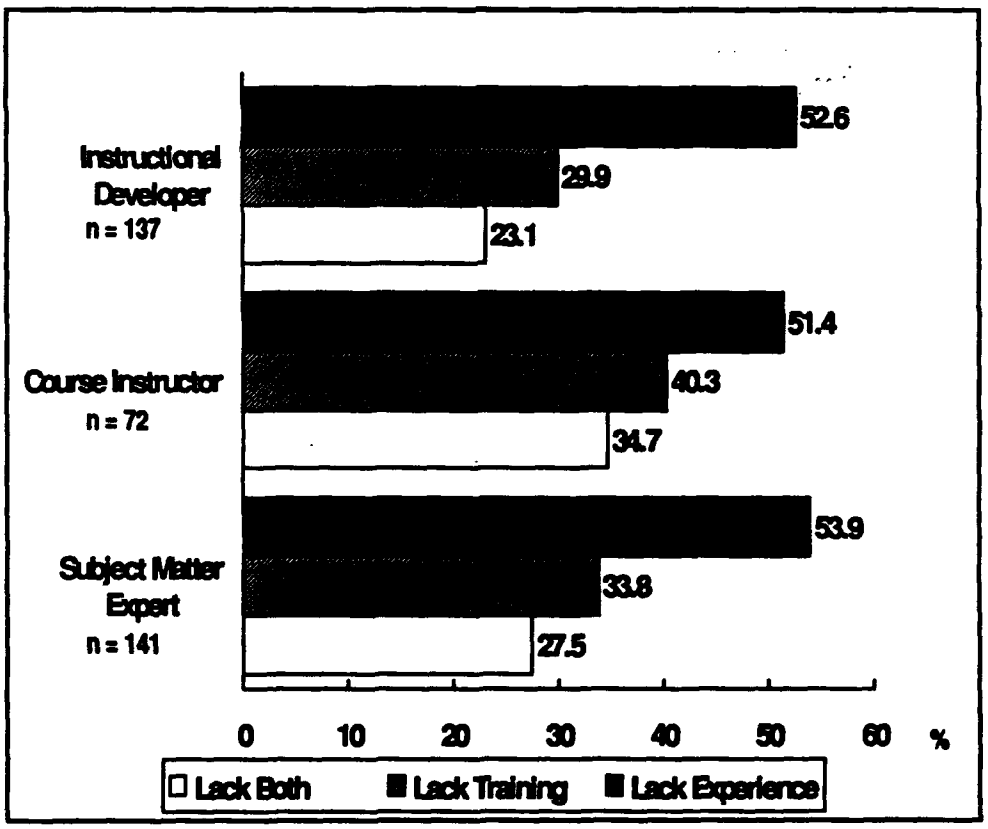
Preparation of CBT Development Personnel

CBT development requires multiple skills. To quote one participant, "Not just *any* person can fill a slot for a courseware developer." In addition to subject matter expertise, it

requires knowledge of CBT instructional design techniques, writing skills, graphic design skills, and some degree of programming ability. Although no single developer needs to have all of these skills, it is best if every developer is familiar with more than one. Unfortunately, a large number of Air Force CBT development personnel are inadequately prepared for CBT development jobs. Figure 9 shows that more than half of the personnel involved in CBT development in each job category are inexperienced, and a large portion of instructional developers (23.1%), course instructors (34.7%), and SMEs (27.5%) lack both training and experience. The lack of experienced and/or trained personnel can be attributed to four primary reasons.

- o High turnover
- o Inability to obtain qualified CBT personnel
- o Lack of planning for training
- o Insufficient training

Figure 9. Development Personnel Lacking CBT Experience, Training, or Both

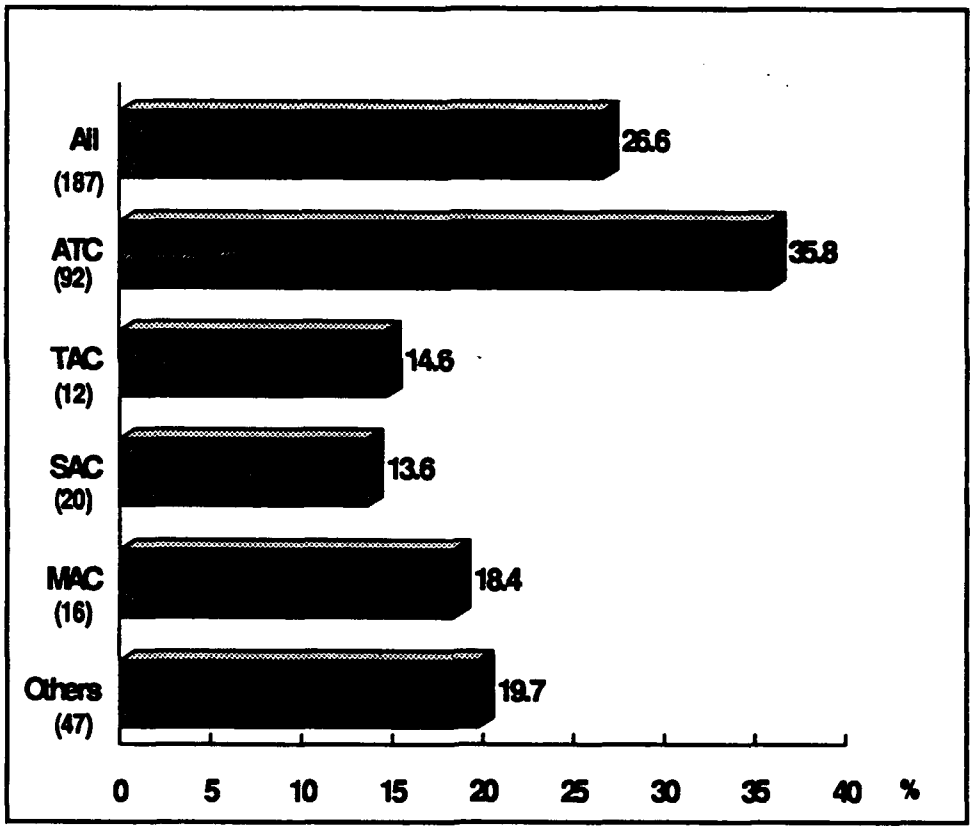


Note. Expressed as percentages of respondents reporting that the given job categories on their development team lacked experience, lacked training, or lacked both. Data from survey questions 58, 65, 67, 68 & 70.

Turnover of CBT personnel

Air Force organizations continually lose qualified CBT personnel because of high turnover. Figure 10 shows the average percent of turnover reported for the aggregate and by command. Turnover is defined here as the percent of personnel leaving a CBT development over one year. The average percent of turnover reported for the sample was 26.6%. So, on average, CBT development teams lost at least one out of four personnel during a CBT development effort. As most project managers know, high turnover on any project can adversely affect schedules and product quality. The problem is compounded when high turnover is coupled with the inability to replace experienced personnel.

Figure 10. Mean Percentage of Turnover by Command

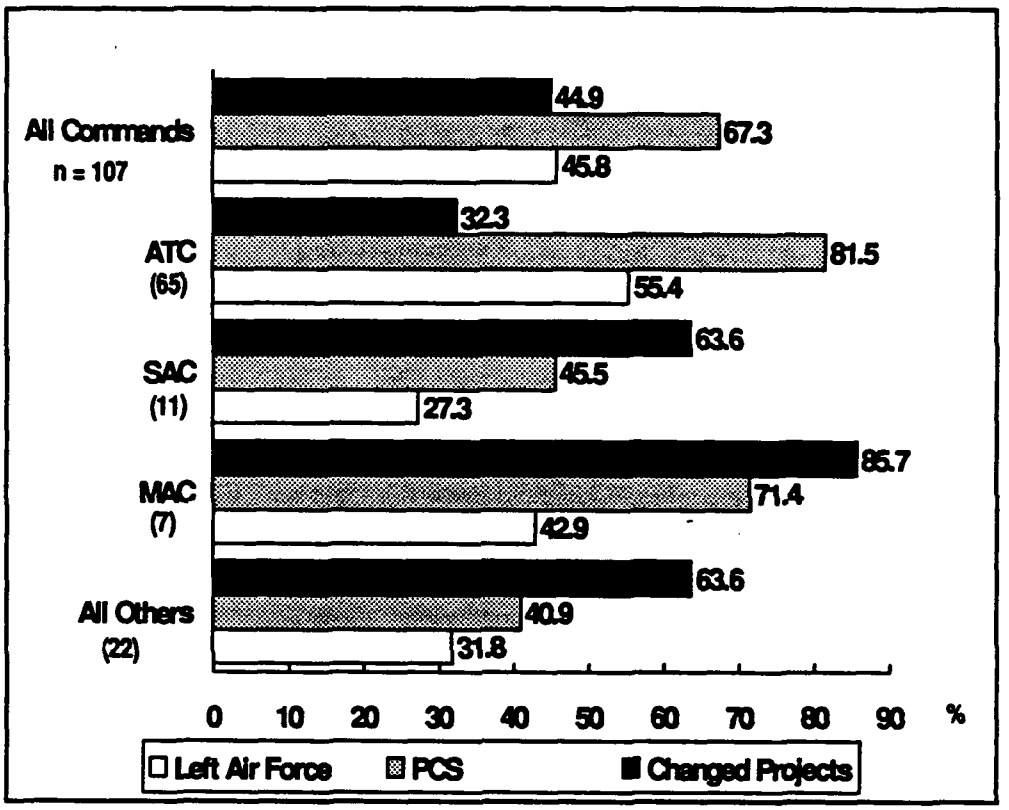


Note. Expressed in the percentage of respondents from the given command who answered survey questions 89 & 90, and Personnel Profile Questionnaire.

Respondents reported several reasons for turnover, including transfer of personnel to other projects, transfer to another duty station, or leaving the Air Force. Figure 11 shows, by command, the reasons for turnover reported by respondents. All commands except ATC reported changing projects and reassignment of personnel as the most frequent causes of CBT

project team personnel turnover. Respondents from ATC cited reassignment and leaving the Air Force as the most common reasons for turnover.[11]

Figure 11. Reasons for Personnel Turnover by Command



Note. Expressed as percentages of respondents who reported that personnel were lost due to turnover. The three possible reasons were not mutually exclusive, i.e., respondents could check off all reasons that applied. Data from survey questions 89 & 91.

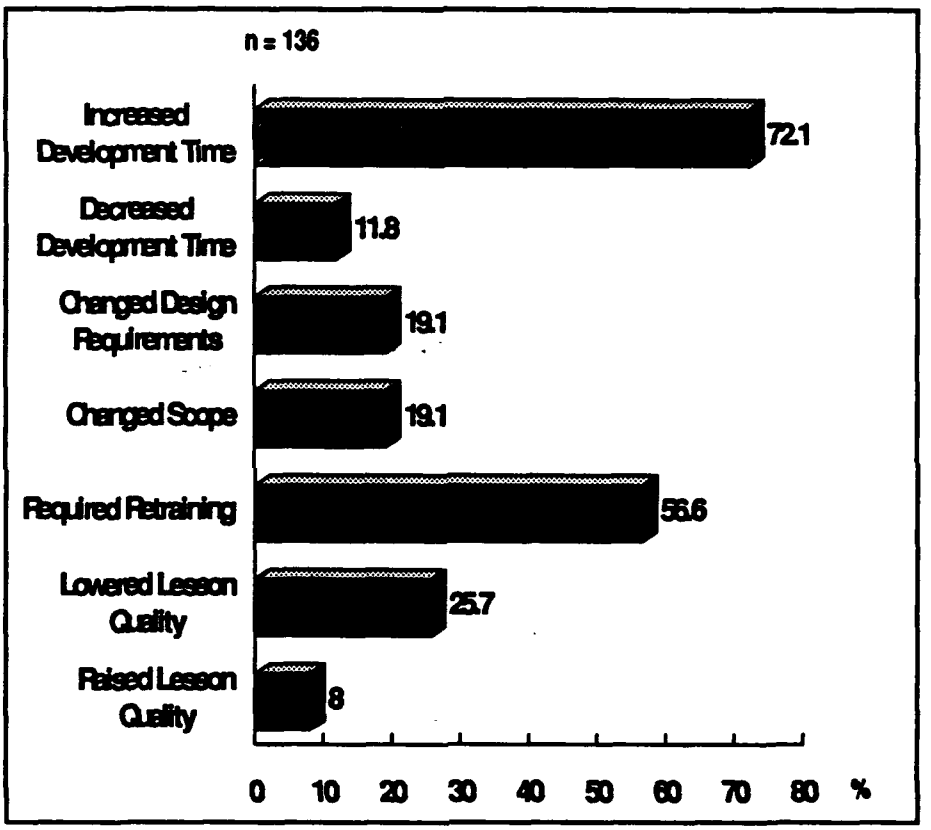
It is noteworthy that changing projects is cited so frequently as a reason for turnover, especially by SAC (63.6%), MAC (85.7%), and commands (63.6%) other than ATC. Certainly, the high degree of turnover must affect a CBT project. Figure 12 shows that the most frequently observed effects were that development time increased (72.1%) and retraining was required (56.6%). Figure 6[12] shows that turnover was a major reason why the budget did not accurately anticipate actual costs (42.1%). It was already shown to contribute to project overruns. This survey did not quantify the effect of turnover on courseware quality but the survey data do show that 25.7% of the respondents said turnover does adversely affect CBT quality.

[11] The large percentage of ATC participants influences the totals for "All Commands."

[12] This figure is fully explained in the section "CBT Planning Procedures."

ATC reported more CBT personnel being reassigned (81.5%) and leaving the Air Force (55.4%) than other commands. In contrast, ATC has a much lower percentage of personnel being reassigned to another project (32.3%) than the other commands. It appears almost twice as likely that personnel assigned to an ATC CBT project will continue with it contrasted to other commands. It is a sound strategy whether based on conscious management policy or occurring by coincidence.

Figure 12. Typical Effects of Personnel Turnover



Note. Expressed as percentages of respondents who reported that development personnel were lost due to turnover. Data from survey questions 89 & 92.

Obtaining Qualified CBT Personnel

The turnover of experienced CBT personnel would not be as great a problem if organizations could more easily replace them with qualified CBT personnel. Two commonly cited reasons for not using personnel with CBT experience for CBT development were that qualified personnel were not available (55.6%), or they were working on other projects (15%). Another reason why some Air Force organizations are unable to obtain qualified CBT personnel

may be the assumption that CBT personnel must also be subject matter experts (SMEs). Many organizations believe that it is easier for an SME to pick up CBT skills than it is to try to teach subject matter knowledge to an experienced CBT developer. In contrast, many contractor CBT developers tend to rely on instructional designers and developers as the core of the CBT development team, with the SMEs changing to meet individual project requirements. The respondents reported that experienced CBT personnel were not used because they did not have background in the subject matter (29.3%). Another 12.8% indicated that experienced developers were not required, which may again indicate a belief that CBT experience is valued much less than subject matter knowledge. Both types of skills are necessary, whether they are found in a single developer or shared across the development team.[13]

The main reason it is difficult to obtain qualified personnel is probably that there is currently no way to identify for assignment Air Force personnel with CBT skills. One of the most commonly mentioned problems in the survey discussion section (24.7%), and the interviews (25.2%) was the lack of an Air Force Specialty Code (AFSC) or special experience identifier (SEI) for personnel with CBT experience. The researchers and Armstrong Laboratory scientists also had difficulty finding experienced CBT personnel for this survey. The approach was to contact organizations that were currently developing or implementing CBT programs. This method may also be used by Air Force organizations attempting to obtain experienced CBT developers.

CBT Developer Training

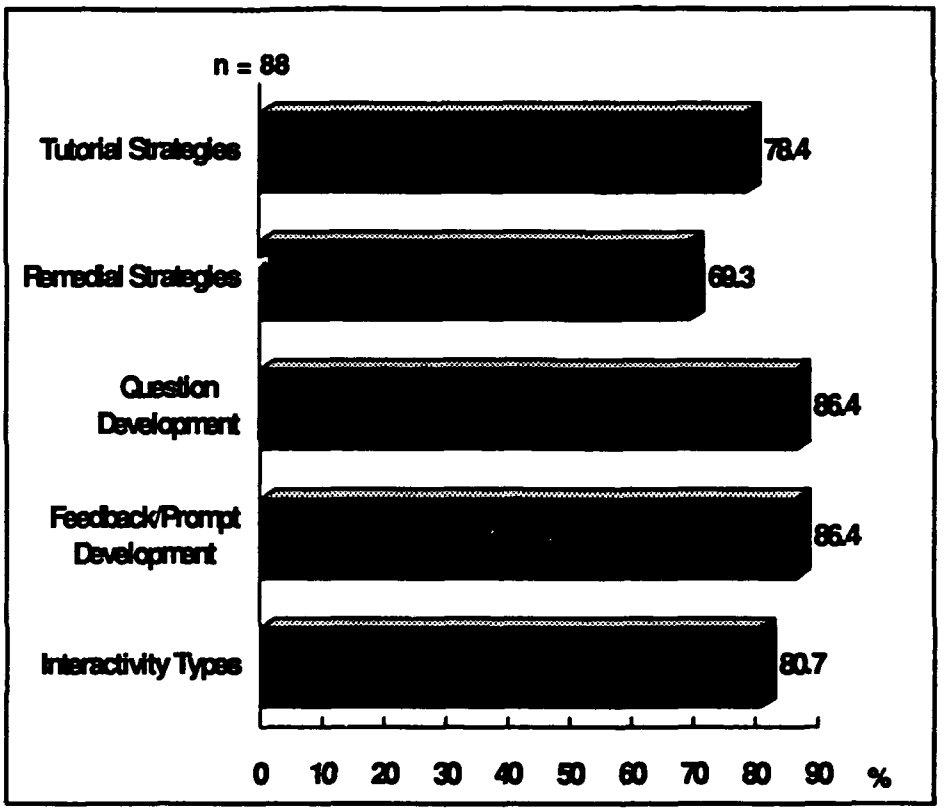
Since it appears that over half of Air Force CBT development personnel are inexperienced, it seems especially important that they receive adequate training. However, Air Force planners often neglect to anticipate and provide for this need. Various reasons were given for not providing CBT training. In some cases training was not provided because there was no time for it (37.8%), training was not available (25.4%), or training cost was not budgeted (13.4%). Each reason suggests a lack of proper planning for CBT. Only 36.6% of the respondents reported that training was not necessary because personnel were experienced.[14]

Figures 13 and 14 show the content of training received by developers. The only notable weak areas appear to be in CMI (53.7%), software structure (48.8%), and software modification (33.1%). These will be discussed later in this report.

[13] Data from survey questions 65 & 66.

[14] Data from survey questions 68 & 69.

Figure 13. Content of CBT Training



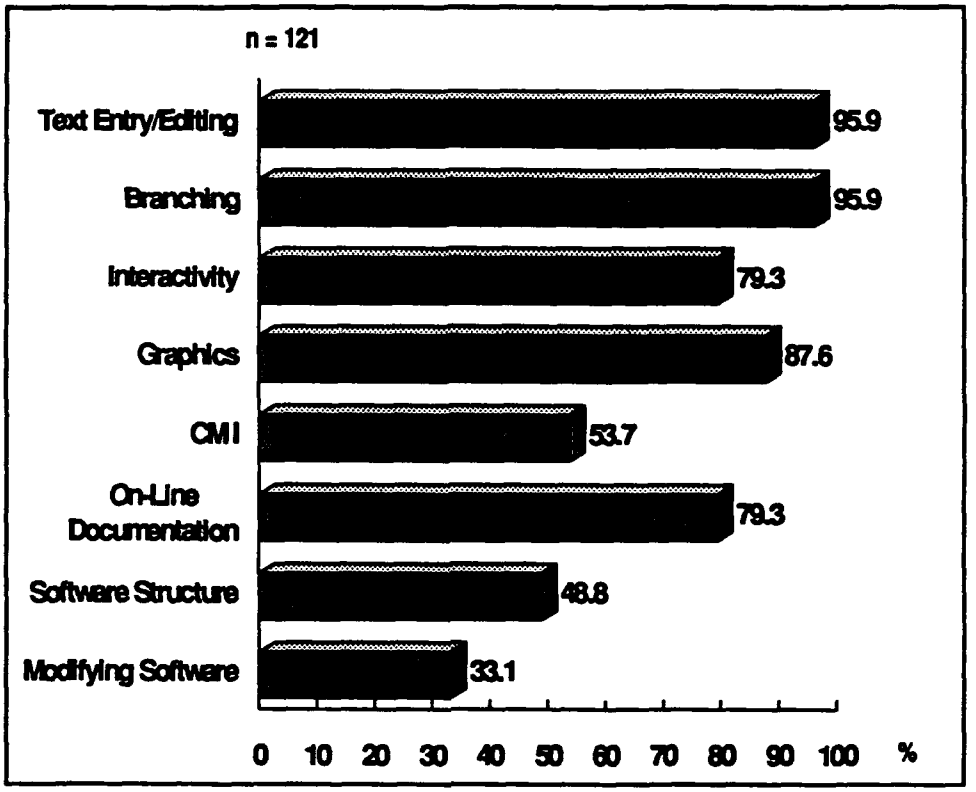
Note. Expressed as percentages of respondents reporting that CBT Training was provided. Data from survey questions 68 & 71.

Although 35.4% of respondents reported that CBT training was not available, there are numerous sources of CBT training which might have been tapped.[15] Nevertheless, personnel are being put into positions of responsibility on CBT projects without training; not surprisingly, there are numerous comments.

- "Personnel have been tasked to develop courses without adequate training, expertise, and guidance."
- "Most of my training has been self-taught."
- "The more training, the better. Developers can't get enough."

[15] ATC runs a Computer-Based Instruction (CBI) Designers course at Sheppard AFB, (J3AZR75000-003) and an IVD Designers course (E3AZR75000-001) and an IVD Managers course (E3AZR75000-000) at Keesler AFB. In addition, there are numerous CBT authoring courses conducted by the various vendors of authoring system software.

Figure 14. Content of Authoring Software Training



Note. Expressed as percentages of respondents reporting that authoring software training was provided. Data from survey questions 119 & 120.

Summary

The Air Force is faced with the problem of having inexperienced personnel work on CBT projects. While inexperience can be corrected by training, it appears that CBT project managers do not provide training for their personnel, or do not know where to get the required training. As long as the Air Force is faced with the problem of identifying experienced CBT personnel, training new developers will be a constant requirement.

Effective Use of CBT

Every instructional medium has specific capabilities associated with it. CBT includes the ability to present graphics, animation, audio, video and simulation on the same platform; to interact with students; to provide self-paced instruction; and to track student progress and prescribe remediation or enrichment as necessary. Effective use of CBT involves taking full advantage of these capabilities whenever it is instructionally valid to do so (Alessi and Trollip, 1985). The data suggest that Air Force CBT personnel are not utilizing CBT to its full potential. Although they are using some CBT features, they are not yet taking advantage of all the

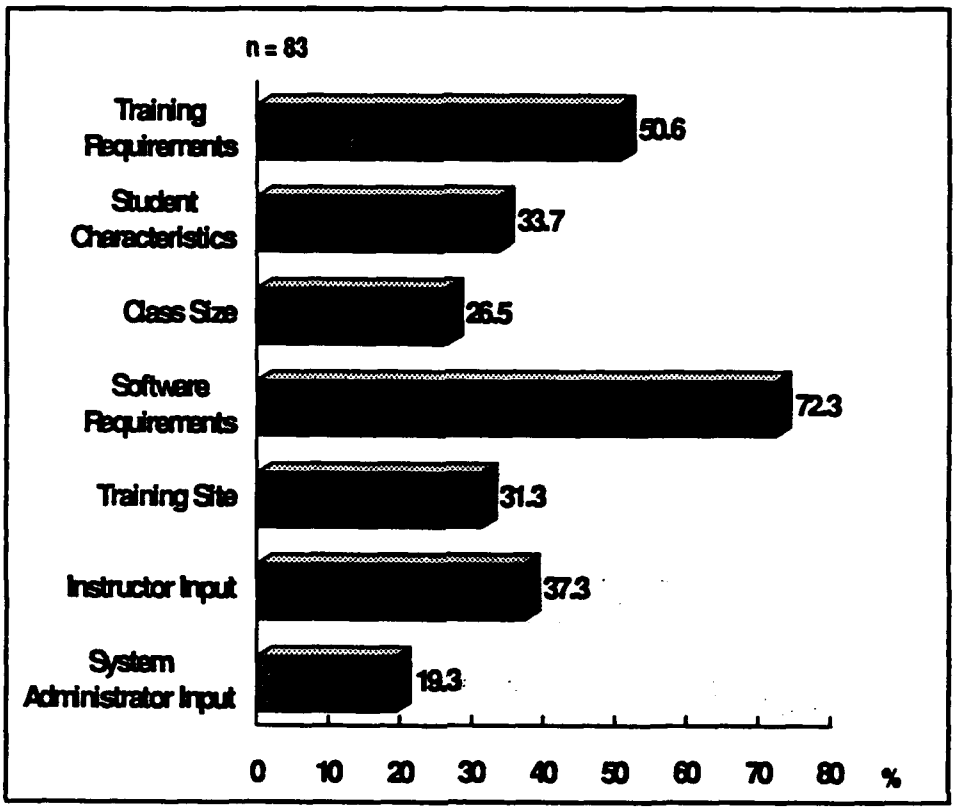
capabilities of the medium. This may be due to many factors, including a lack of understanding about what goes into the selection of a CBT system.

CBT System Selection

Systematic selection of CBT hardware and authoring software is critical to the effective use of CBT because it directly affects the kinds of lessons that can be developed. Perhaps the most important consideration in selecting CBT hardware and software is whether or not the hardware and software selected allow developers to create instructionally effective lessons that meet training requirements. For example, if there are requirements for the students to learn switch actions using a control panel, the need for a touch screen should be a consideration during hardware selection in order to facilitate learning and enhance the transfer of skills from the training environment to the actual job. The data indicate: 1) hardware seems to be selected based on which software runs on it; 2) there seems to be a lack of awareness that training requirements should be the *primary* consideration in CBT system selection; 3) CMI is only taken into account slightly more than half of the time; and 4) student characteristics are infrequently considered.

Figures 15 and 16 show that software requirements seem to drive the selection of hardware (72.3%), and that software is selected based on features other than meeting training requirements. While three factors -- ease of use (78.5%), presentation capabilities of the authoring system (75.3%), and hardware requirements (67.7%) -- are reported to be taken into account most often in selecting CBT software, there are other factors considered by the CBT system selection team. Certainly, it is important to ensure that the CBT system can be used by developers with little or no effort, and that it is capable of taking advantage of a wide variety of presentation features. However, making the developer's job easier with a *user-friendly* CBT system which does not offer the *single feature* that addresses the most critical training objectives will counteract any effort to develop quality training.

Figure 15. Considerations in Hardware Selection



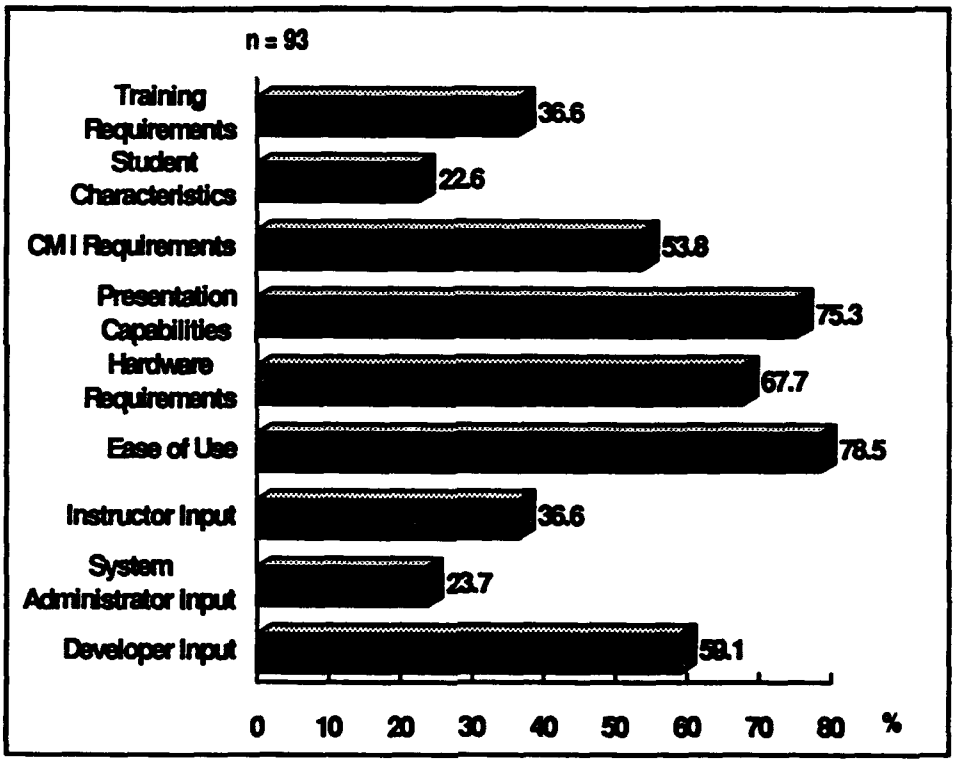
Note. Expressed as percentages of respondents who reported that the given issues were considered during the hardware selection process. Data from survey questions 49 & 51.

When only 53.8% of the respondents report considering CMI requirements in selecting a CBT system it may be that CBT is being used like other training media, rather than as the self-teaching, self-managing tool of trainers that it was intended to be. This might be expected based on the low percentage of system administrators (23.7%) and instructors[16] providing input to software selection. However, both CMI and other considerations may be secondary to the *higher authorities* that ultimately make the CBT system decision. Over two-thirds[17] of the respondents indicated that such decisions were made by *higher authorities*.

[16] The percentage of instructor input reported varies depending on which specific question is analyzed. When respondents were asked about the job categories involved in hardware (24.1%) and software (22.6%) selection the percentages were lower than when asked if instructor input (36.6%) was considered. In either case, the percentages of input from this group are quite low.

[17] Based on hardware selection (67.5%) and software selection (66.7%).

Figure 16. Considerations in Software Selection



Note. Expressed as percentages of respondents who reported that the given issues were considered during the software selection process. Data from survey questions 52 & 54.

Finally, it seems that there is little effort to match the CBT system to the learning styles of the students, since student characteristics are infrequently considered (22.6%). When these pieces of information are put together they form a picture of CBT system selection based on characteristics which include ease of use for the developer and, perhaps, *looks*, i.e., presentation capabilities. This indicates the need for more guidance for personnel who select CBT systems.

Utilization of CBT Media Features

Air Force CBT developers appear to use CBT as if it were a conventional training medium. During the interviews many participants indicated that their courses were converted to CBT from other media such as stand-up instruction, workbooks, or slide-tape presentations. However, Air Force developers appear to be using many of the presentation modes supported by CBT; 95.2% reported that graphics were developed, 48.2% reported use of audio, and 45.4% reported use of still or motion video. Graphics were used most frequently for systems diagrams (83.1%) and to display equipment (80%). Video was most often used to teach identification (e.g., of parts of an equipment panel, parts of a human body, etc., 84.3%) and procedures (e.g., equipment panel operation, use of a stethoscope, etc., 75.7%). These applications of graphics and video suggest that the capabilities of CBT are being used well. However, audio may be

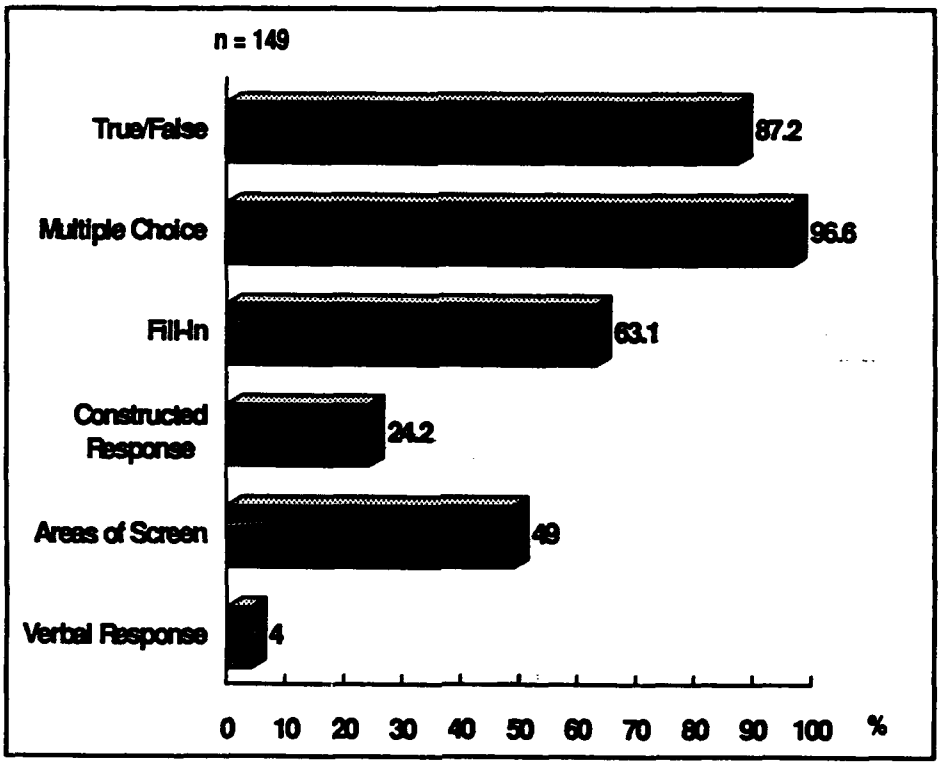
used less effectively. Some of the least commonly used types of audio cues were signals (30.9%) and engine sounds (11.1%). If CBT were being used to simulate the job environment, one would expect these types of cues to be used more frequently. Instead, audio is most often used for rewards (45.7%), which is more typical of *page turning* than high quality CBT; and verbalizations (65.4%), i.e., spoken directions or explanations, which are an excellent application of audio for students with lower reading aptitudes. While there appears to be wide scale use of the various CBT features, it may still be necessary for Air Force developers to *change their paradigm* from converting traditional instruction to CBT, to making full creative use of CBT.[18]

Evaluation Features. Unlike their ability to take advantage of the graphics, video and other presentation features of CBT, Air Force developers have not yet begun to take full advantage of the evaluation power of CBT. Almost all Air Force developers utilize embedded questions (93.8%) and feedback (98.7%) in lessons.[19] However, as with presentation features, developers are not using evaluation features in a manner which allows them to test student performance in ways which closely approximate on-the-job performance. Figure 17 shows the types of questions used. Multiple choice (96.6%) and true/false (87.2%) predominate. Less commonly used are questions which require indicating an area of the screen by moving the cursor or touching a pointer (49%), constructed response (24.2%) and verbal response (4%). Since most Air Force CBT lessons are technically oriented and graphics depicting equipment are frequently used, one would expect "area of the screen" type questions to be used more frequently. The widespread use of multiple choice and true/false questions suggests that Air Force CBT developers are oriented toward paper-and-pencil type testing, even though the computer is capable of more complex testing modes (Horowitz, 1988). Once again, this indicates the need for developers to break out of the *old instructional paradigm.*

[18] Data from survey questions 130, 132, 137, 138, 140 & 141.

[19] Data from survey questions 125 & 128.

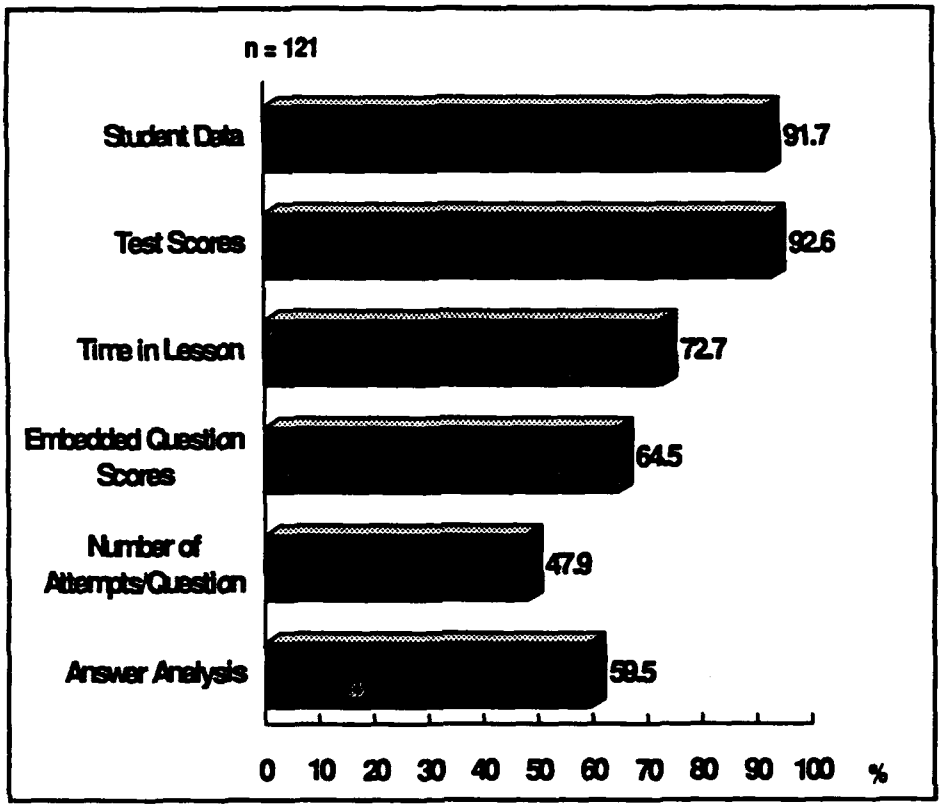
Figure 17. Types of Questions Used



Note. Expressed as percentages of respondents who reported that questions were embedded within the lessons. Data from survey questions 126 & 127.

CMI Features. Computer-Managed Instruction (CMI) can be a powerful tool when used effectively. The computer can be used to keep track of various indicators of student performance, to prescribe remediation or enrichment as needed, and to free the instructor to concentrate on student problems. However, CMI is not being used effectively in the Air Force where it is used as a computerized gradebook rather than as a tool to help prescribe training. Figure 18 shows the types of CMI data collected. The items most commonly collected were test scores (92.6%) and student demographic data (91.7%). Less frequently collected were time in lesson (72.7%), embedded question scores (64.5%), answer analysis (59.5%), and number of attempts per question (47.9%); however, these capabilities could be employed for more sophisticated teaching functions, such as assigning students to particular lessons or courses based on their performance.

Figure 18. Types of CMI Data Collected



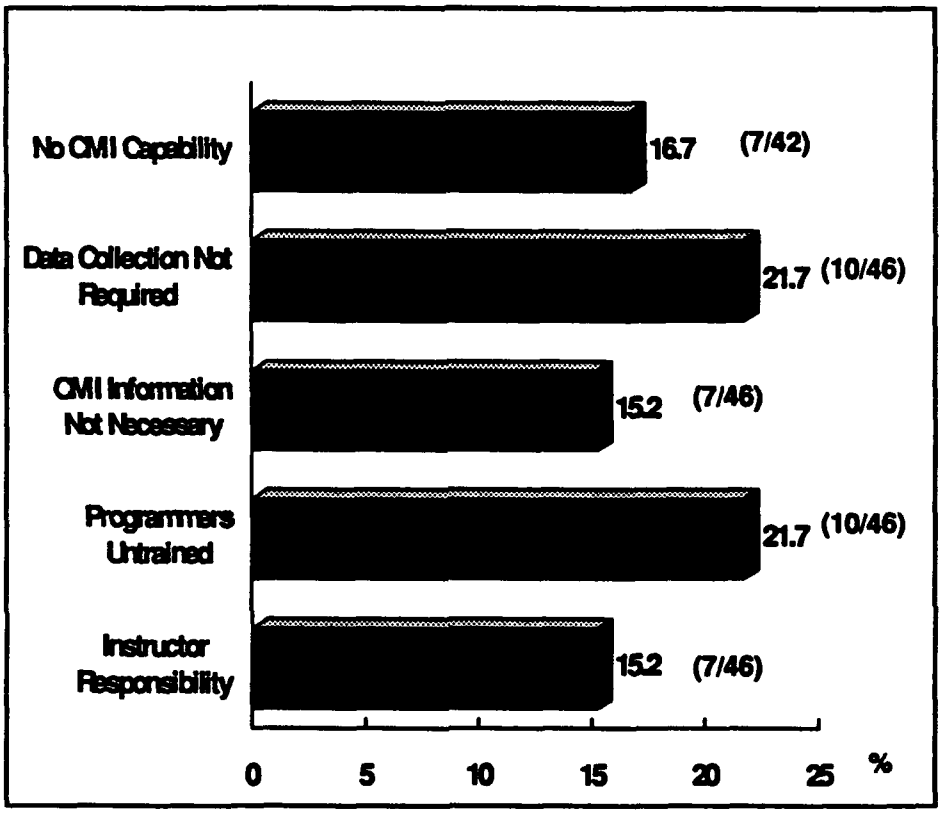
Note. Expressed as percentages of respondents reporting that the computer was utilized for CMI. Data from survey questions 122 & 123.

The number of respondents reporting use of the computer for CMI was lower than expected (72.5%). This may be because many developers are unaware of the benefits of CMI. Figure 19 shows that frequently cited reasons for not utilizing the computer for CMI include "Data collection was not required" (21.7%); "Programmers were not trained to develop CMI" (21.7%); "Information collected by the CMI was not necessary" (15.2%); and "The instructor was responsible for data collection" (15.2%). All of these reasons suggest that many Air Force CBT developers are still thinking in a conventional training mode.

One interesting finding concerning CMI is "Authoring software did not provide CMI capability" (16.7%). If student scheduling and management capabilities are desired, CMI requirements must be defined before the authoring software is selected. As one respondent pointed out, "I'd like to stress the importance of identifying all user expectations of CMI early on, and ensuring CMI is addressed thoroughly throughout the acquisition and acceptance phases." Another respondent complained about the authoring system selected: "No meaningful data can be extracted from the system for input into CAMS. If the student can't take the course and get credit in CAMS, he won't bother." If the requirement for compatibility with CAMS had

been identified early, it could have been considered in the software selection process. However, only 53.8% of respondents[20] indicated that CMI features were considered in the authoring software selection process.

Figure 19. Reasons Why CMI Data Not Collected



Note. Expressed as percentages of respondents reporting that the computer was not utilized for CMI. Data from survey questions 122 & 124.

On-Line Help Features. A useful feature of CBT is its ability to provide readily accessible reference information to students as they go through lessons. Simply by pressing a function key or selecting an item from a pull-down menu, etc., a student can access information, such as a technical order (T.O.) references, glossaries, diagrams, and charts. Ideally, on-line help should function as the CBT equivalent of a job aid. In many cases, on-line help is not provided to Air Force trainees. Only 74.4% of participants indicated that on-line help was developed for students. The reasons for not providing on-line help suggest a lack of understanding of how to use this feature. The most commonly cited reason was "Such assistance was not required" (60%). It would be interesting to know if the students felt the same way about

[20] See Figure 16, "Considerations in Software Selection."

this assistance. Other reasons included "The authoring software did not support help screens" (22.5%) and "Programmers were not trained to develop on-line documentation" (20%).[21] Figure 20 shows the types of on-line help offered. The most commonly available types of on-line help were glossaries (63.4%) and T.O. or manual references (42.9%). Less available types included lesson maps (39.3%), diagrams (35.7%), and charts or tables (34.8%). One way of determining the kind of on-line help required and how often it should be available is to carefully assess student characteristics and match these with the training requirements. Although 83.8% of the respondents reported that student characteristics were used to determine training modes,[22] use of on-line help indicates that such information is not being utilized fully.

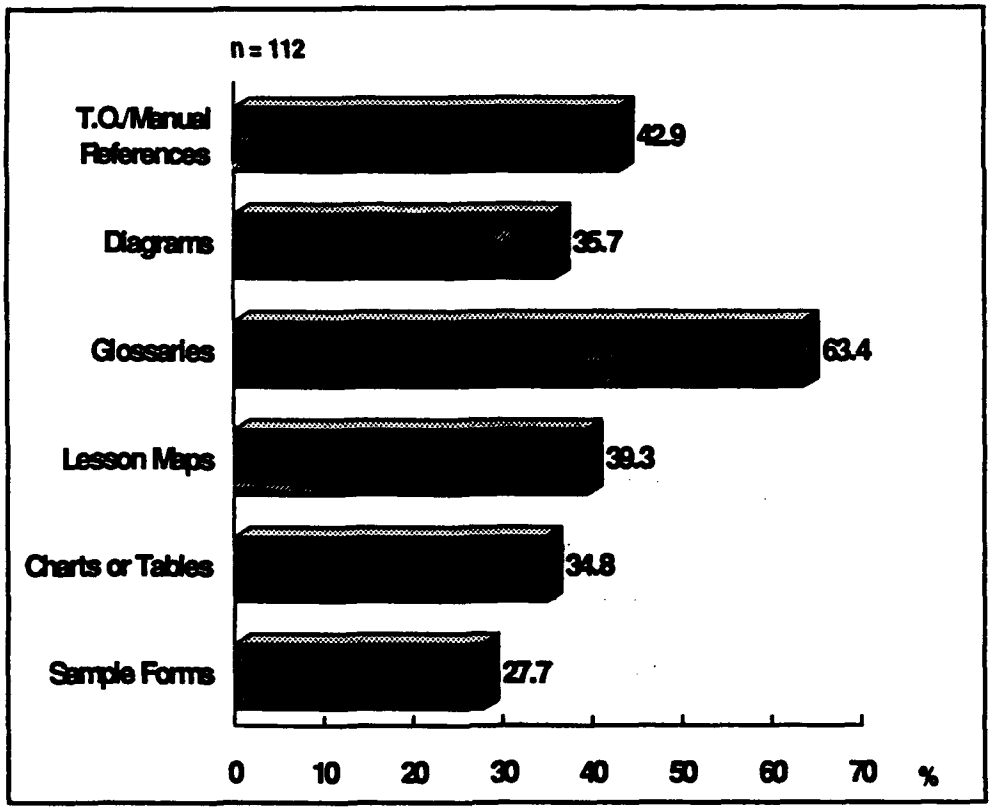
Ability to Offer Self-Paced Instruction. CBT can provide one-on-one instruction to students at any time and in almost any place. While CBT does not presently, and may never, completely eliminate the need for human assistance, it can either reduce the number of instructors required per class, or eliminate the need for formally scheduled classes (Orlansky and String, 1979). The majority of survey participants were from formal schools, where we should expect CBT to be applied to eliminate training bottlenecks, reduce training time or eliminate the need for a dedicated instructor. CBT should facilitate the migration of training from formal schools to job-site. The data suggest the Air Force is not yet taking full advantage of this capability. Most respondents (80.4%) indicated that an instructor was available to assist students as they went through the CBT courseware, suggesting that CBT is being used in some kind of formal training environment, perhaps in a classroom setting. Additionally, class sizes are fairly small,[23] which suggests that instructors are still teaching and that instruction is probably *lock step*, thereby negating the power of CBT as a teaching medium.

[21] Data from survey questions 143 & 144.

[22] Data from survey questions 14 & 16.

[23] 70.2% of the classes have 12 or fewer students.

Figure 20. Types of On-Line Help Offered



Note. Expressed as percentages of respondents who reported that on-line help was developed to assist the students as they progressed through the lessons. Data from survey questions 143 & 145.

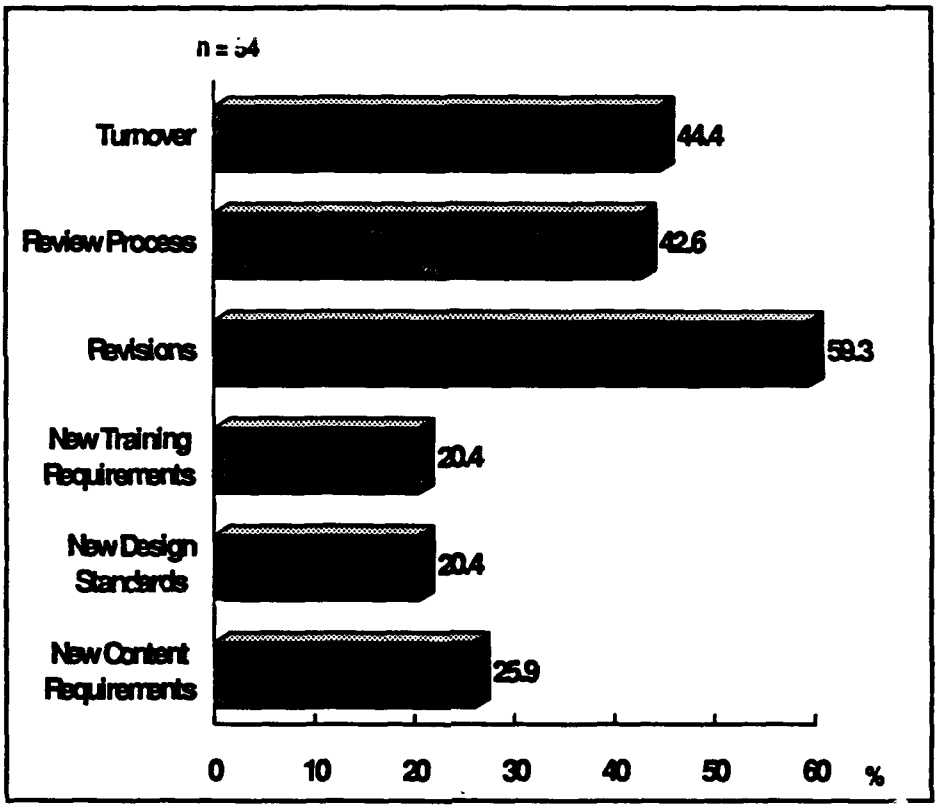
Summary

These data indicate that more work is required to change the traditional orientation of Air Force CBT users and developers so they can take full advantage of CBT's power. Both CBT developers and faculty must reorient their way of thinking away from classrooms and traditional instructor-guided learning environment to a student-centered environment that makes use of all the CMI features of CBT. This reorientation will require a significant commitment from all levels of Air Force leadership.

Efficiency of the CBT Development Process

Survey data indicate Air Force CBT courseware development appears to be frequently delayed, over budget, and inefficient. This is expected considering the problem areas discussed so far. Often, incomplete planning leads to frequent changes during development. Untrained and inexperienced managers and developers cannot be expected to do things right the first time working with such a complex medium.

Figure 21. Reasons for Delay in Storyboard Completion



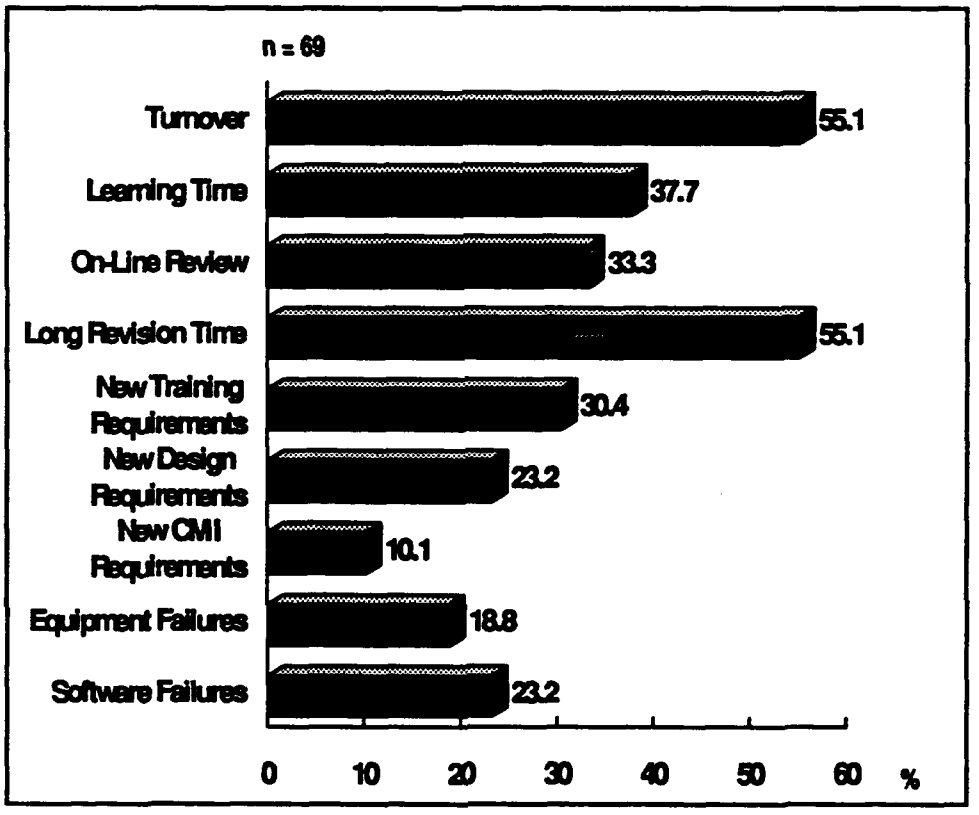
Note. Expressed as percentages of respondents who reported that storyboards were not completed on time. Data from survey questions 115 &116.

Development Schedule

Air Force CBT development is subject to frequent delays in the production of storyboards (35.1%) and the on-line production of lessons (44.4%). These delays probably reflect the effects of incomplete planning, high personnel turnover, and a lack of experienced or trained personnel -- all issues that have been previously addressed. Figures 21 and 22 show the reported reasons for storyboard and on-line lesson delays, respectively. As expected, turnover and inexperience are two of the primary reasons. Other results described in this report point out that a lack of planning and preparation account for several problems. Both storyboarding and on-line lesson production are delayed most often by *revisions*. Although some revision is expected during the storyboard phase of CBT production, it can be controlled by properly defining the training requirements and lesson objectives during Job/Task Analysis. Certainly, revisions during the on-line production phase (55.1%) are not well timed. These data coupled with other reasons cited -- "Training requirements changed" (20.4% for storyboards; 30.4% for on-line lessons), and "Design standards changed" (20.4% for storyboards; 23.2% for on-line lessons) -- suggest inefficiency in Air Force CBT development. For the most part, Air Force

organizations that were able to complete on-line lesson production on time conformed to the standard industry practice of using CBT team members who were experienced and trained in CBT design and development ($p<.05$).

Figure 22. Reasons for Delay in On-Line Lesson Completion



Note. Expressed as percentages of respondents who reported that lesson production was not completed on time. Data from survey questions 152 & 153.

The CBT Review Process

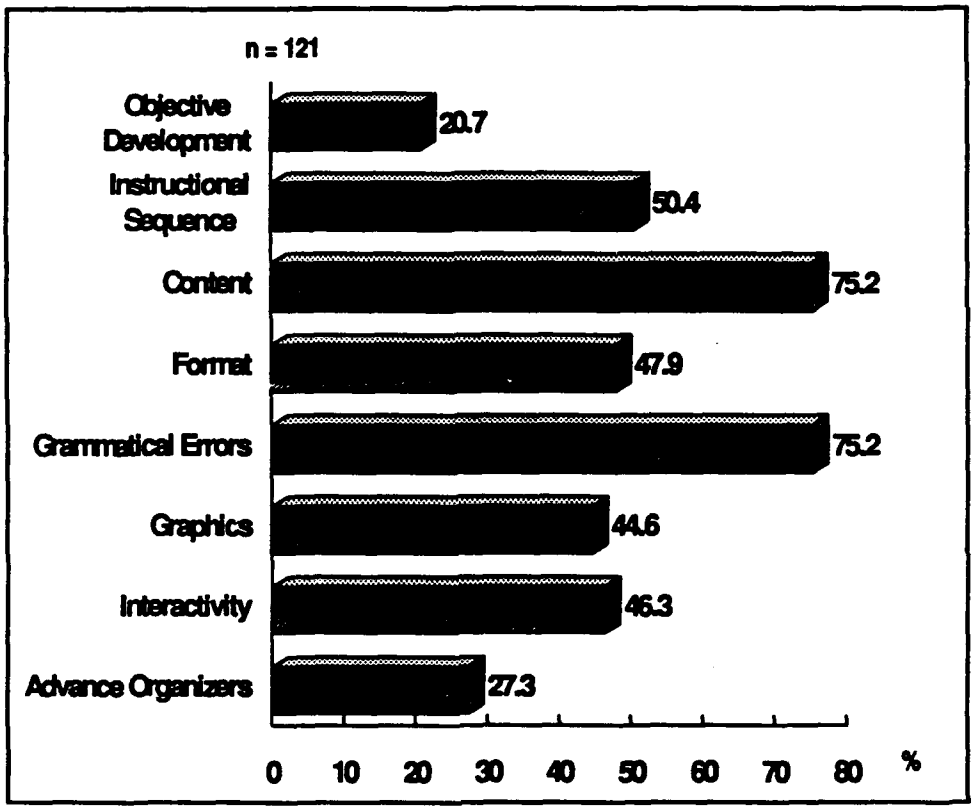
Typically, CBT is reviewed many times in the process of producing a lesson. Reviews usually occur during the development of lesson specifications, during storyboarding, when lessons are first put on-line, and during validation. Unfortunately, lessons attract the most attention when they are put on-line. Many people who should have been initially involved in reviewing lesson specifications or interpreting storyboards get their first look at a lesson when it is put on-line. This is also the least efficient point during CBT development to make major changes. Changes are difficult and time-consuming to make and disrupt lesson and CBT development.

Ideally, major decisions involving course structure, lesson objectives, lesson format, and lesson content should be made prior to courseware development. In addition, many CBT contractors develop a sample lesson to show everyone who is involved in CBT review what to expect. During the storyboard review stage, corrections can address the content of the lesson, method of presentation, graphics, and so on--but these changes should never extend to changing the lesson's objective. On-line lesson review should require even fewer changes. Most changes should have been identified and agreed upon at the storyboard stage, although Air Force CBT development does not seem to follow this approach.

Storyboard review. Of respondents[24] who utilized storyboards for CBT development, 92.1% reported that these storyboards were reviewed by SMEs or course instructors for acceptability. Figure 23 shows the types of revisions resulting from storyboard review; 20.7% of respondents reported that objectives had to be changed. This is a very high percentage considering how late this review takes place in CBT development. Two other items that suggest a lack of front-end planning are the need to revise the instructional sequence (50.4%) and revisions of lesson format (47.9%). Large numbers of these changes should not be necessary at this stage, and reflect the inexperience and lack of training of CBT development personnel surveyed. It should be noted that some emphasis is being placed on student interactivity (46.3%). This could mean that many lessons start out as page turners because of the developers' inexperience with CBT capabilities, or because the developers are converting existing lessons to CBT, as though they were developing a text lesson.

[24] Of respondents 83.2% reported that storyboards were used. Data from survey question 105 & 107.

Figure 23. Types of Revisions Resulting from Storyboard Review

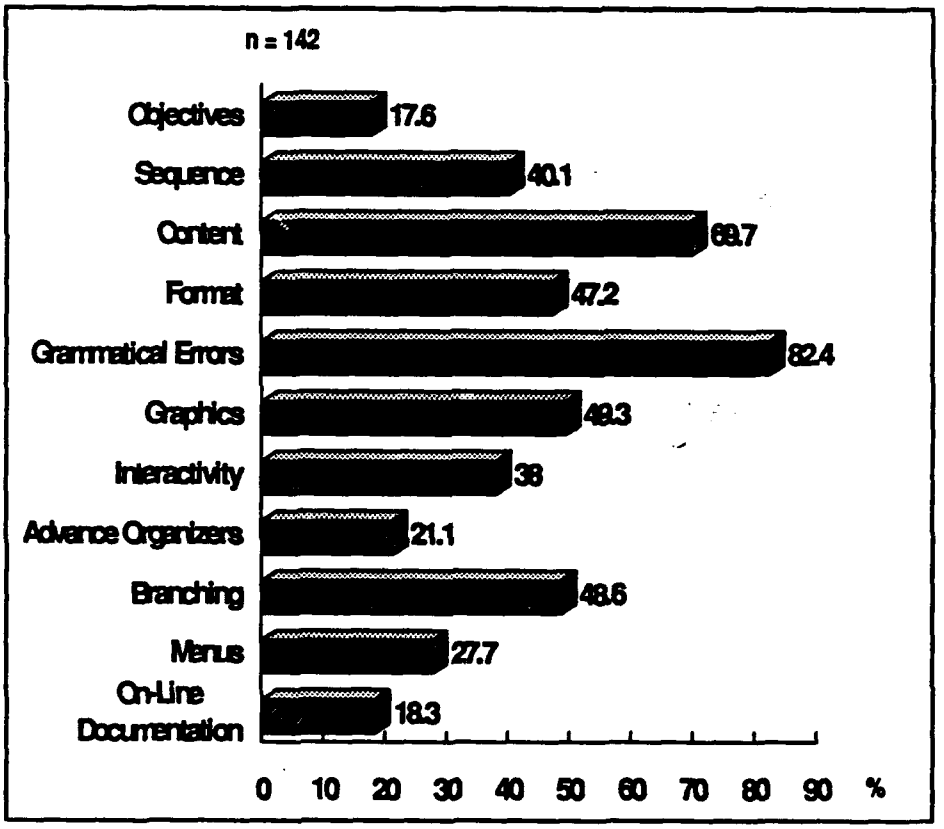


Note. Expressed as percentages of respondents who reported that storyboard revisions were deemed necessary after review. Data from survey questions 107, 110 & 111.

On-line review. On-line review is normally used to identify those few discrepancies that remain in a lesson after the storyboard has been approved. On-line review was conducted by 91.9% of the respondents. Various changes to lessons based on this review are shown in Figure 24. The number of respondents reporting changes to objectives (17.5%) at this stage in CBT development is startling. Changes occurring during this stage reflect the same lack of front-end work previously discussed, including changes to instructional sequence (40.1%) and lesson format (47.2%). In spite of the attention paid to interactivity during storyboard review, other significant revisions (38%) were required. It appears that most of the problems associated with CBT lessons were detected and corrected during on-line review.

Use of audit trail procedures. One common source of inefficiency during review is that changes to lessons are made repeatedly, because there is no record of the rationale for the change. Survey data show that 28.1% of Air Force respondents did not keep records of changes made to storyboards, and 30.3% did not keep records for on-line lesson changes. Conscientious use of audit procedures would encourage efficiency in Air Force CBT development.[25]

Figure 24. Types of Revisions Resulting from On-Line Review



Note. Expressed as percentages of respondents who reported that revisions were required after the on-line review. Data from survey questions 147, 150 & 151.

Summary

The inefficiency reflected in CBT development is probably related to the lack of experience and training of many personnel. These problems might also be attributed to a lack of specific, validated guidance on how to develop CBT technologies.

[25] Data from survey questions 112 & 154.

Standardization

In any large organization such as the Air Force, standardization is important because it facilitates information dissemination and exchange. There are two types of CBT standardization: (1) standardization of CBT configuration (hardware and software) and (2) courseware standardization. Based on our data, the Air Force can improve in both areas.

CBT Configuration

There is no current standard CBT configuration of hardware and software for the Air Force. One advantage of establishing a standard is to facilitate sharing courseware among organizations. Although the survey did not specifically investigate hardware and software standardization, it was frequently mentioned in the discussion section and during interviews. The use of different authoring packages is a particular problem; in one case, as many as six different authoring software packages were being used at the same base. Some developers like to choose among the capabilities of a variety of authoring software packages and feel a standard authoring package would be too restrictive. While we do not advocate a single standard for CBT authoring software to serve all Air Force users because of their differing training requirements, some degree of standardization might be helpful. One representative comment was: "The Air Force has been acquiring CBT training and systems for years, and there is no standard for this CBT. This results in years spent on development of CBT and it is for a sole user with no chance of transportability between systems. This means we 'reinvent the wheel' or design a lesson over and over again for each system. Also, there is no clearinghouse for lessons developed or designed that could be used if there was transportability." The general opinion is that some standardization of CBT configuration is desirable.

Courseware Standardization

There is also need for standardization at the individual course level. This assures agreement among everyone involved at each project stage, and gives a polished appearance to lessons. There are several "tools" for courseware standardization: format (style) guides, sample lessons, flowcharts, and storyboards.

Format guides are collections of rules and standards set by an organization for programming lessons. A typical format guide addresses topics like lesson structure, screen design, colors, use of questions and feedback, branching, titles, and menus (Eckstein, 1990; 436th STS, 1991). Format guides provide all lessons with the same "look," which aids student learning. Format guides also facilitate review and revision of lessons by people other than the original lesson writer or programmer. While many respondents (77.3%) reported that their organizations utilized format guides, the number is less than expected if good CBT development practices were being consistently followed.[26]

Sample lessons complement standardization by demonstrating how a lesson might look. Because many people have difficulty visualizing how a lesson will look based only on a format

[26] Data from survey question 95.

guide description, sample lessons are essential tools in CBT development. However, only 52.1% of respondents reported that sample lessons were used. Perhaps this may be a contributing reason why respondents made revisions in lesson format (47.2%) when lessons were on-line.[27]

Flowcharts depict the sequence and types (e.g., information, question, diagram) of screens which will be used in a lesson and the way the lesson will flow from one screen to another. Developers often use flowcharts to help organize their thoughts; but, flowcharts are most useful as tools to assure agreement among key development personnel so that corrections to lesson sequence, branching, etc., can be made before storyboarding begins. Flowcharts are used by 77% of respondents. Although a relatively large number of respondents use flowcharts to standardize lessons, 50.4% also reported changes in instructional sequence due to storyboard review and 40.1% due to on-line review. Either the developers ignored the flowcharts, did not understand their use or the flowcharts were incorrect.[28]

Summary

Standardization of CBT systems and development approaches can lead to more efficient use of CBT in the Air Force. However, using existing standardization procedures can improve CBT if everyone understands the procedures and how to take advantage of them. This also supports the need to provide additional training for CBT developers.

Validation

The primary purpose of validation is to determine whether or not the courseware achieves the specified standards by effectively teaching objectives to the target audience. Although 93.1% of respondents reported that courseware was successfully validated, it is unlikely that rigorous validation takes place in many Air Force CBT efforts based on types of validation activities performed and the organization of validation plans.

Types of Validation Activities

There are several types of validation activities that are conducted including formative and summative evaluation (Gagne and Briggs, 1979; Dick and Carey, 1985). Common procedures are to conduct a formative evaluation with instructors, SMEs and individual students, then conduct a summative evaluation with representatives of the student population first in a small group, and finally, if time and resources allow, with a large group in a setting as much like the intended training environment as possible. The data shown in Figure 25 suggest that many Air Force CBT developers fail to validate courseware with members of the target audience. It appears that validation, if attempted, usually consists of instructor or SME review (64%) and tryout lessons with individual students (71.1%), i.e., formative evaluation. Far fewer conduct summative evaluation (small group try-outs 53.5%, large group tryouts 35.1%), and even fewer attempt to relate the training to job performance (28.9%). These numbers indicate that some limited validation activities are taking place.

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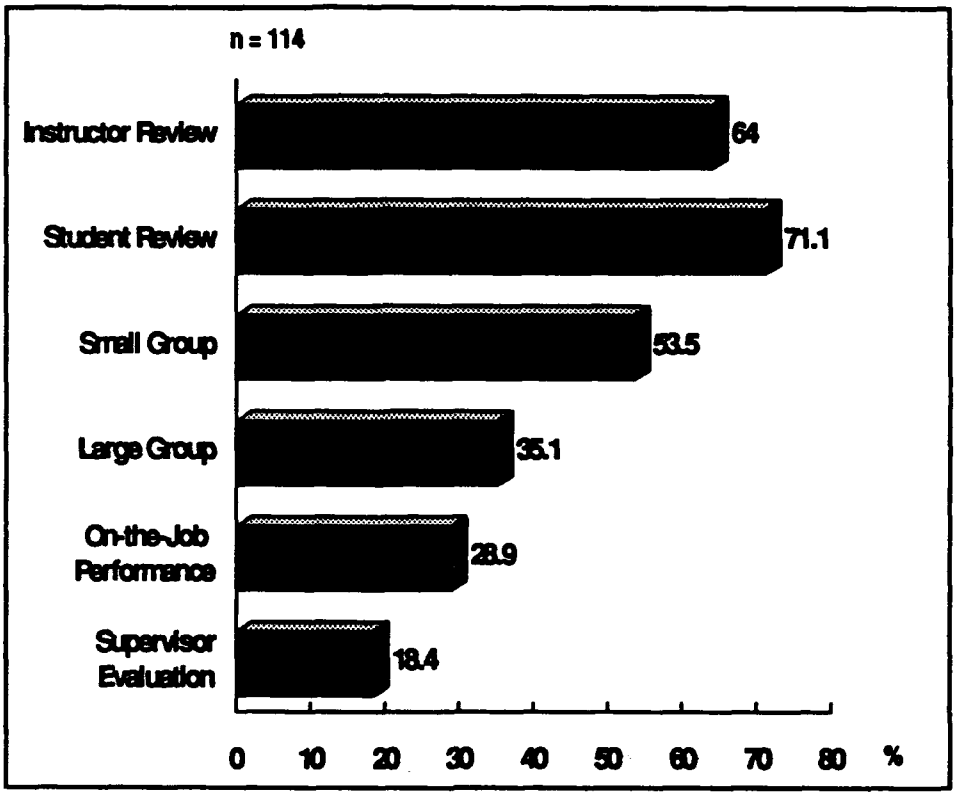
[27] Data from survey question 98.

[28] Data from survey question 102.

Figure 25. Types of Validation Activities Performed

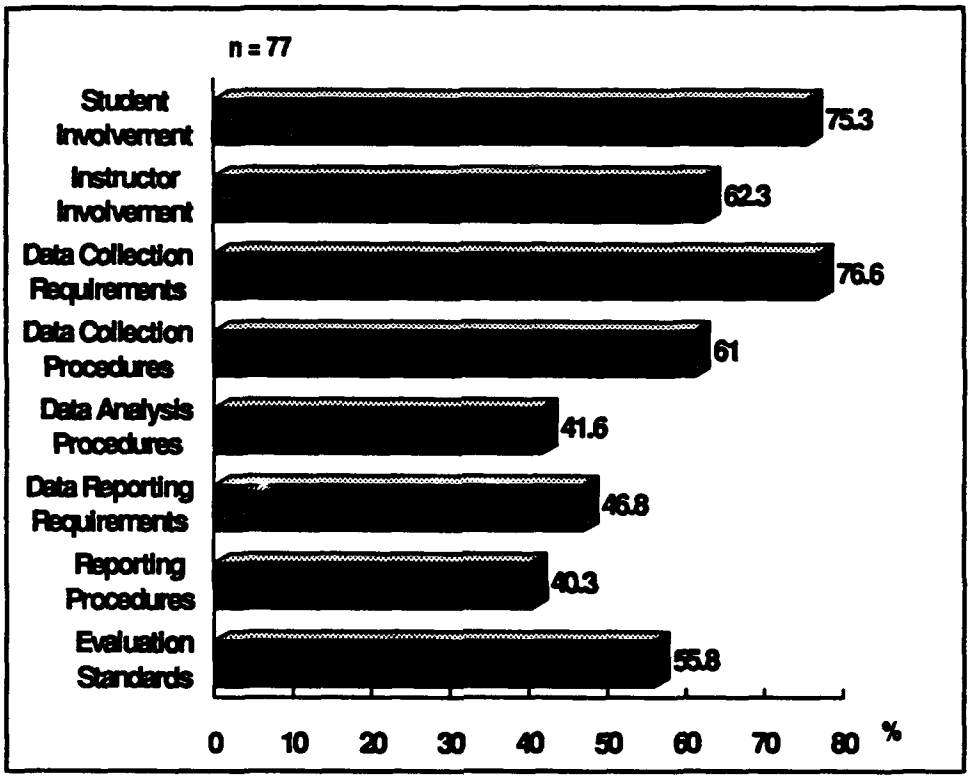


Note. Expressed as percentages of respondents who were involved in the validation of CBT lessons. Data from survey questions 158 & 160.

Validation Procedures

Validation, like most complex CBT procedures, is normally guided by a plan. The plan identifies data to collect, procedures to follow, and standards of evaluation to achieve. The quality of the courseware, as well as the experience of the development team can be revealed by examining the validation plan. Many respondents (68.8%) reported using a validation plan. A large percentage of Air Force organizations probably did not have a plan to guide courseware validation. Even those organizations that developed a validation plan did not seem to understand validation. Figure 26 shows the typical items specified in validation plans. For example, 24.7% did not describe student involvement; 37.7% failed to describe instructor involvement; 23.4% did not specify the data collection requirements or data collection procedures to follow (39%), or what to do with the data once collected (58.4%). Perhaps the most telling item is that few respondents (55.8%) had specified the standards to be achieved at the end of the validation phase.

Figure 26. Contents of Validation Plans



Note. Expressed as percentages of respondents reporting the use of a validation plan. Data from survey questions 161 & 162.

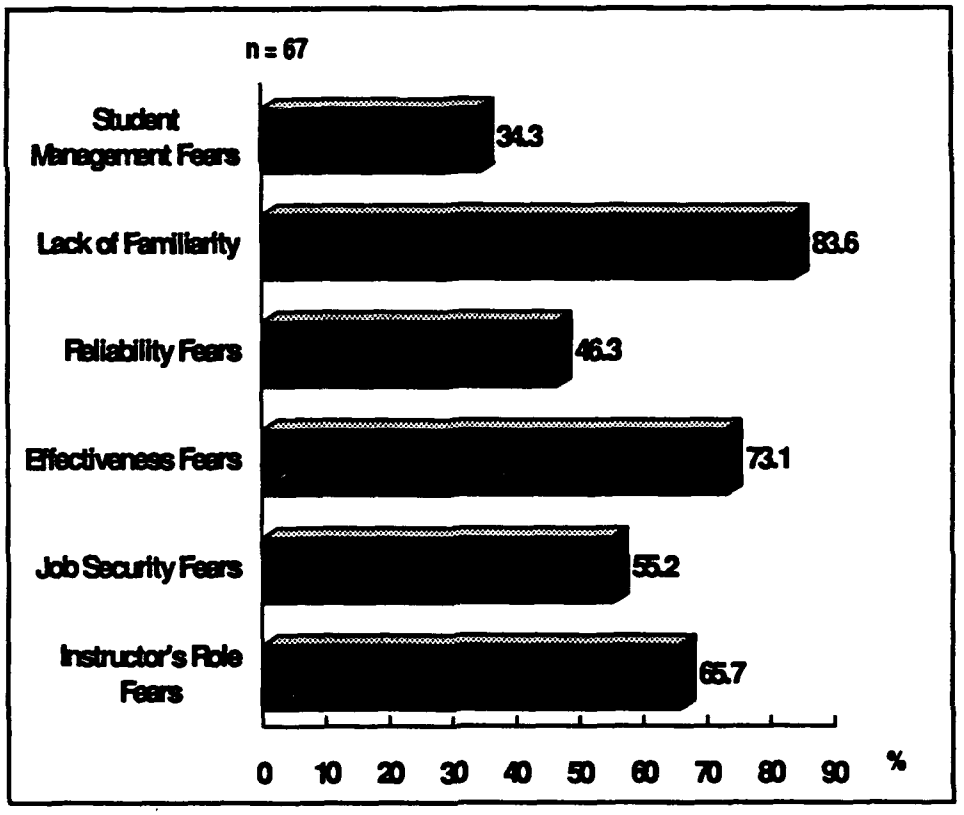
Summary

Survey data indicate that the Air Force is not conducting effective validation of CBT. This tends to fit in with the lack of coordinated planning for CBT apparent from the survey. Without effective validation the Air Force cannot determine if the courseware is achieving the training objectives, and furthermore, if the courseware and objectives match the job requirements.

Implementation

Implementation of CBT in the Air Force often appears to be complicated by student and instructor reluctance to accept the courseware. Participants agreed that this was not a serious problem because eventually almost everyone adjusts to the situation. The reasons for student reluctance should be further investigated. Some reasons for instructor reluctance can be determined from the data. In general, these problems can be minimized if instructional staff and students are sufficiently prepared to accept their new roles.

Figure 27. Reasons for Instructor Reluctance to Use CBT



Note. Expressed as percentages of respondents who reported that instructors were reluctant to teach using CBT. Data from survey questions 178 & 179.

Instructor Reluctance to Use CBT

Instructor reluctance to use CBT was reported by 64.4% of respondents. The reasons reported in Figure 27 suggest that instructors do not receive enough training to overcome their fears and misconceptions about CBT prior to implementation. As one participant remarked, "One of the biggest things that I think is wrong is that our instructors are not taught how to effectively deal with the CBT (IVD, CAI) environment. Because of this no matter how good or professional your product is, it will never be any good to them."

The survey distinguished between two types of training for instructors: "training on the system," i.e., how to use the system; and, "training in CBT instructional techniques," i.e., how to use CBT effectively as an instructional tool. Although 86.5% of respondents reported that instructors received training on the system, only 56.4% indicated that instructors received training on CBT instructional techniques.[29]

[29] Data from survey questions 180 & 183.

The instructor's role in a CBT training environment is often quite different from their role in traditional education and training (Andrews and Trainor, 1987; Stephenson, 1991). Instructors may be reluctant to give up the spotlight. One respondent indicated that former platform instructors have the most difficult time adjusting to CBT. Survey data showed that more instructors are reluctant to use CBT in a formal environment than in an informal environment. Perhaps this is because formal school instructors are accustomed to being the focus of attention; whereas on-the-job training supervisors are used to an informal, over-the-shoulder style of helping the student.

Student Reluctance to use CBT

Many students (46.5%) were reluctant to use CBT. Commonly cited reasons include "lack of familiarity with the system" (74.6%); "lack of keyboarding skills" (47.5%); and "concern about system reliability, e.g., answer judging, student advancement, etc." (20.3%). These problems could be easily remedied either with proper student preparation for CBT or by using another input device whenever possible. Another reason for student reluctance was "difficulty reading information presented on the computer screen" (20.3%). This reflects poor CBT lesson design that could be corrected by developers having more experience or training in screen design.

Summary

Student and faculty reluctance to use CBT may be eliminated with specialized training. Faculty involvement in CBT development as reviewers of the courseware, or as SMEs will quickly overcome their fears of CBT and make them feel part of the team, rather than as recipients of training developed by someone else.

Maintenance

Problems with CBT hardware and software can delay CBT development and disrupt implementation. Fortunately, most Air Force hardware and software problems appear to be relatively minor. Many could be alleviated with better planning and preparation of personnel. The sections below describe specific problems with networks, hardware, authoring software, and documentation.

Network Problems

Networks are useful when several students use the computer at the same time or when other software, in addition to CBT, must be shared by the users. A significant proportion of respondents (58.4%) are using networks for their CBT systems. [30]

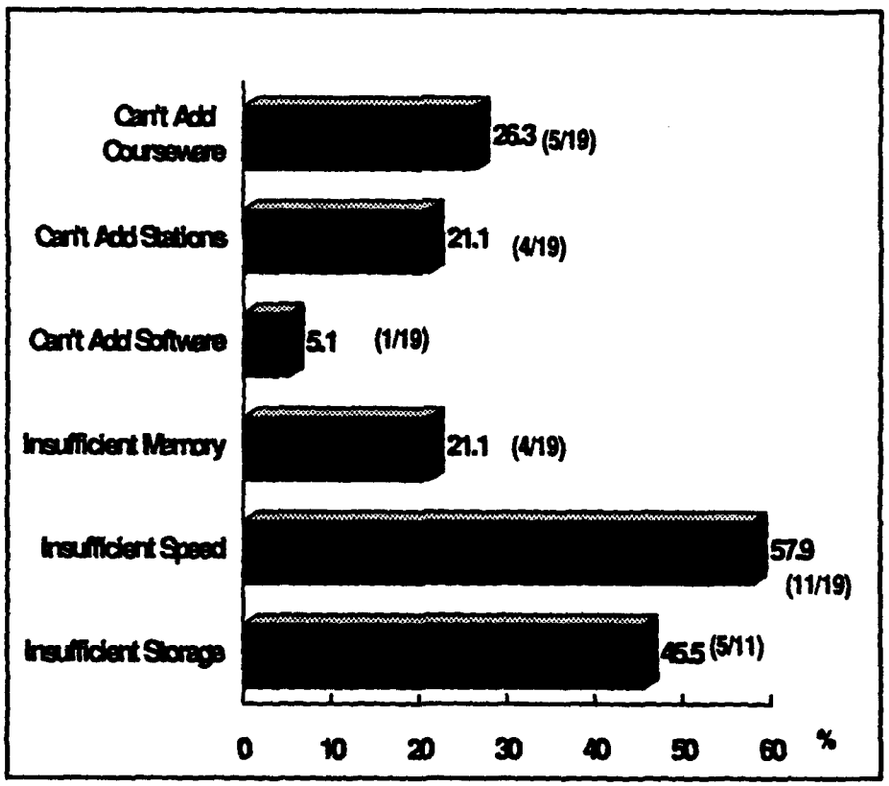
Networks can reduce the cost-per-student for software and allow lessons and CMI data to be stored in one location rather than duplicated on several different computers or on floppy

[30] Data from survey question 208.

diskettes (Air Training Command, 1989). However, network performance may be degraded if there are too many users or the system may simply run out of storage capacity. Such problems can be avoided or alleviated if factors such as class size, training site, and software requirements are considered during the planning stage.[31]

Two problems with networks were investigated: (1) problems associated with student load exceeding system capabilities (27.3%) and (2) problems sharing the system, i.e., use of it for other types of applications in addition to CBT overloading the system capacity (25.7%). Figure 28 shows the consequences of these problems, including degradation of system speed (57.9%) or storage (45.5%). Other negative effects were that the organization was not able to add more courseware (26.3%), could not add more student stations (21.1%), or did not have enough memory for the storage of data such as student files. Each of these problems can be attributed to a lack of proper planning for the CBT system during its acquisition phase.

Figure 28.Types of Problems with Networked CBT Systems



Note. Expressed as percentages of respondents who reported that the requirements to share the system hardware exceeded its capabilities. Data from survey questions 211 & 212.

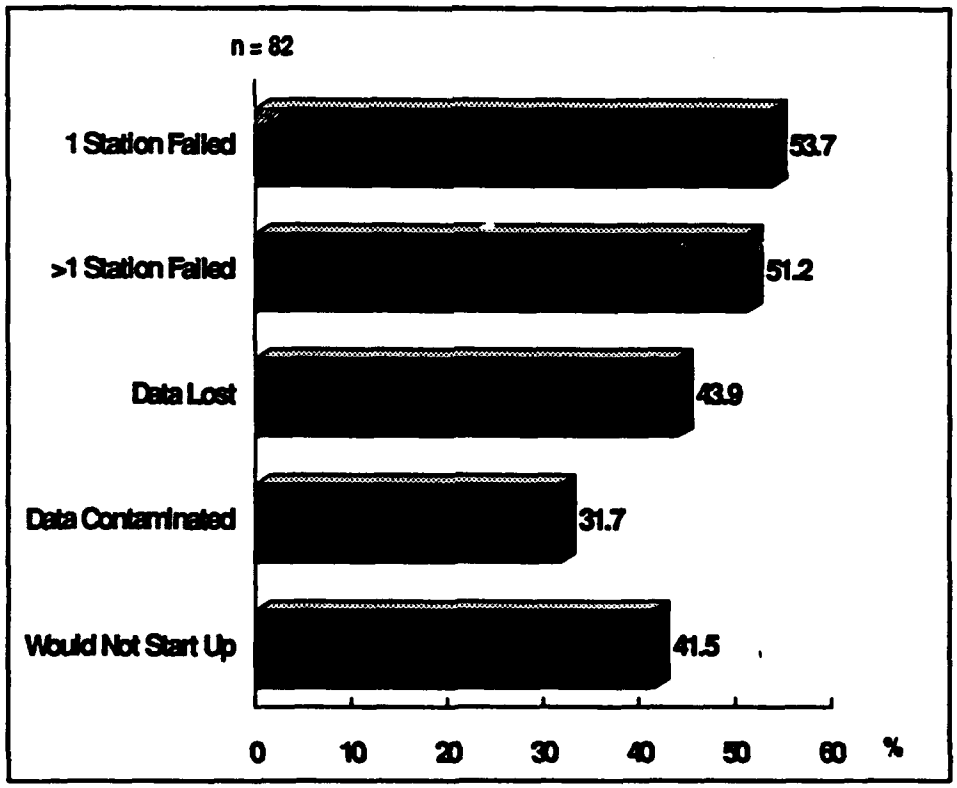
[31] Figure 15 verifies that class size (26.5%) and training site (31.3%) were not widely considered factors during hardware selection.

Hardware Problems

Hardware failures were experienced by 73.9% of respondents. To some extent, hardware failures are inevitable. The main issue is whether or not they have a deleterious effect on training operations, e.g., loss or contamination of data, inability to conduct training, etc., and whether or not the failure can be handled by available personnel.

Some hardware failures experienced by Air Force CBT organizations can be fairly serious. Figure 29 shows that data were sometimes lost (43.9%) or contaminated (31.7%). Ideally, serious problems should be handled either by an on-site computer specialist, i.e., a system administrator, or by a maintenance contract with a system vendor to minimize down-time. However, 22.6% of respondents reported that a system administrator was not available, and 30.5% reported that hardware maintenance contracts were not purchased.[32] These data indicate that some problems associated with hardware failures might be prevented by prior planning.

Figure 29. Types of Hardware Failures



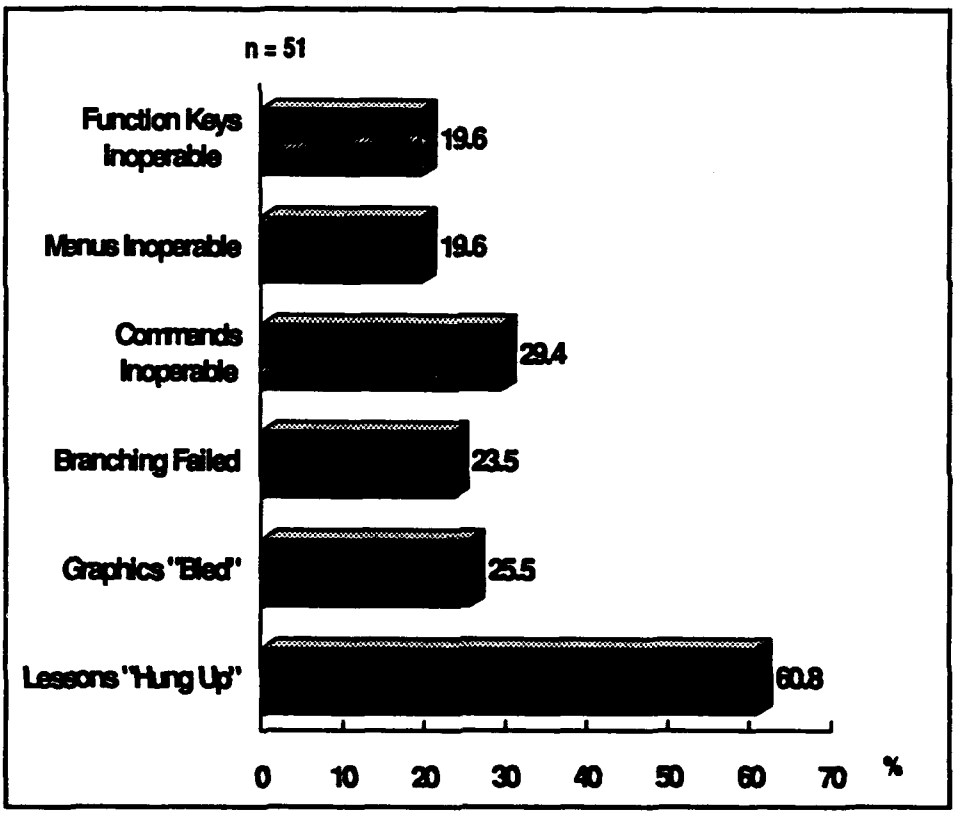
Note. Expressed as percentages of respondents who reported that hardware failures had been experienced. Data from survey questions 213 & 214.

[32] Data from survey questions 173 & 215.

Software Problems

Software problems may be classified into two categories: (1) software bugs and (2) inadequate software capabilities. Software bugs were reported by 53.1% of respondents. Figure 30 shows several typical authoring software problems. Some of these, such as "commands inoperable" (29.4%) and "function keys inoperable" (19.6%), can potentially handicap development and student ability to use the system. The problem cited most often, "lessons 'hung up'" (60.8%), may be due more to poor programming, i.e., inexperienced developers, rather than to problems with the software. These types of software problems are generally best handled by a system administrator or lesson developer in consultation with the software manufacturer. However, 60.4% of respondents reported that authoring software maintenance contracts were not purchased.[33]

Figure 30. Types of Software Problems



Note. Expressed as percentages of respondents who reported that they experienced problems with the authoring software. Data from survey questions 218 & 219.

[33] Data from survey question 220.

Some developers cited the following inadequate software capabilities.

- o "The system is extremely slow when four or more people are on line. Graphics do not allow animation. Graphics are 'drawn' on screen rather than simply appearing in final form. This is extremely distracting and subject to critiques by 99% of students."

- o "System software was not designed for graphics construction, thus, it is very tedious to design graphics. Also, graphics display is slow. Editing audio is almost as frustrating as graphics design. It is a long, drawn-out process--time-consuming and tedious. Audio delivery, on the other hand, is one of the system's strong suits."

Once again, these problems can probably be attributed to the lack of an adequate software selection process and a general lack of planning for CBT.

Documentation Problems

Authoring software documentation is essential for courseware developers; 87.4% of respondents indicated that they used documentation. However, good software documentation is not always available; 26.4% of respondents reported that the documentation provided by the software vendor was not sufficient. Documentation problems can be minimized by making good documentation a software selection criterion.[34]

Summary

Maintaining a CBT system in good operating condition consists of more than just reacting to hardware or software problems. Proactive planning by CBT managers during the front-end analysis; making use of desired or required features as part of the selection criteria in a trade-off analysis of CBT systems; and, making use of computer expertise for system planning ensures adequate maintenance and efficiency of CBT systems.

IV. DISCUSSION

The goal of this Air Force CBT survey was to identify issues with broad application for Air Force users and to characterize how various organizations handled them. Anyone involved with the medium knows that every CBT project encounters some problems during its life-cycle. By investigating these problems, improvements to Air Force CBT planning, selection, development, and implementation procedures can be made, and ultimately the quality of training throughout the Air Force can be improved.

This report has outlined several significant issues which were described by organizations involved in CBT, including:

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[34] Data from survey questions 224 & 225.

- o Planning for CBT
- o CBT management
- o Training of CBT development personnel
- o Capabilities of CBT
- o CBT development procedures
- o Standardization of CBT systems and procedures

Planning for CBT

This report contains numerous examples of ineffective planning for CBT. ISD principles and procedures should be followed throughout CBT development. The data show that some ISD steps have not been performed.[35] Some survey data indicate that the required steps may not be completely understood, for example, validation.[36]

The effects of incomplete planning permeate the entire CBT development process. There are cost and schedule problems that can be directly related to lack of planning and inexperience (see Figure 6). Managers failed to plan properly for the initial cost of hardware and software, for maintenance costs, or to train personnel. They incorrectly estimated the time for CBT development, review of lessons, and revisions.

Many problems associated with ineffective CBT planning can be corrected by providing CBT managers and developers with clear guidance and training on what to do and how to do it. Several new tools and documents will soon be available to provide that guidance. The Air Training Command is developing a new Air Force pamphlet to provide that guidance. Air Force Pamphlet 50-68, Information for Designers of Instructional Systems is a multi-volume pamphlet which includes an interactive courseware (ICW) decision guide, an ICW developer's guide and the *Guidelines for CBT Planning, Selection, and Implementation* mentioned earlier. ATC is also developing the *Training Cost Estimator System (TRACES)* which will provide cost estimates of training course costs, including CBT course costs. The Armstrong Laboratory has developed the *Guidelines for Transportable Education and Training (GTET)*,which provides procedures and cost and scheduling models for turning resident courses into transportable courses of various forms, including CBT.

CBT Management

Our survey respondents were dissatisfied with CBT management in regard to providing guidance, scheduling and coordination of team efforts and other program resources. They

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[35] See Table 3 which shows accomplishment of CBT planning. Of all respondents only 77.6% performed Training Needs Assessment, 67.1% -- Job/Task Analysis, 83.1% -- Analysis of Trainee Characteristics, 64.1% -- Facilities Requirements Assessment, 50.0% -- Media Analysis, and 86.9% Developed Training Objectives.

[36] Of the 68.8% who reported using Validation Plans, very few included vital information necessary to conduct the step properly (see Figure 26). Air Force validation activities center around student and instructor review of the courseware rather than any formal test of its effectiveness.

viewed their managers as inexperienced (see Figure 8), and tended to blame management for most CBT problems. Many Air Force CBT managers are truly inexperienced and this contributes to problems in planning CBT. Even when managers did plan for CBT, they frequently took the wrong factors into consideration, such as in hardware and software selection (see Figures 15 & 16). There have been problems in developing CBT which may also be attributed to ineffective management. It is unclear whether or not delays in storyboard completion (Figure 21) and on-line lesson completion (Figure 22) can be attributed to inexperienced managers or poor planning. Ultimately, completing programs on schedule is a management responsibility. While further research into the problems of CBT management is warranted, it appears that current managers need additional training and guidance in how to plan, develop and implement CBT.

Personnel Factors

Air Force CBT efforts are seriously affected by personnel factors. Most CBT projects start with less than half of the team having CBT experience and many untrained instructional developers and SMEs (see Figure 9). Approximately one in every four members of the CBT team leaves before the project is completed (Figure 10). Identifying and keeping experienced personnel is a difficult task for CBT program managers. More than half of the respondents (55.6%) reported that CBT experienced personnel were not available for development. CBT managers should be aware that even modestly ambitious schedules cannot be met when inexperienced and untrained personnel form the majority of the development team. Air Force organizations are faced with the decision of not starting a CBT project or finding ways to identify experienced personnel, to train inexperienced personnel and, then, to retain them. Identification of Air Force personnel with CBT experience will require action from the personnel system to flag and track such individuals for future assignments. Efforts are under way to address the problems of lack of CBT training and experience. The Armstrong Laboratory is developing an *Advanced Instructional Design Advisor (AIDA)* to provide inexperienced instructional developers with guidelines for authoring computer-based instruction. ATC is working to provide as many spaces in their existing CBT management and development courses as possible. The Armstrong Laboratory is also pursuing a research effort parallel to the AIDA mentioned above. The *Guided Approach, Instructional Design Advisor (GAIDA)* provides guidance, following Dr. Robert Gagné's nine events of instruction, to inexperienced CBT developers.

Capabilities of CBT

If the Air Force were fully utilizing CBT there would be more individualized instruction, efficient use of CMI capabilities, extensive use of graphics, video and audio to simulate the job environment, and a wide variety of evaluation techniques used to diagnose learning problems and prescribe assistance. Respondents (72.5%) reported using the computer's CMI capabilities. Most of this group were using CMI to provide testing results rather than to diagnose student problems and provide tailored remediation or enrichment (see Figure 18). With such a heavy reliance on inexperienced personnel to develop CBT, it will be difficult for the Air Force to substantially improve the situation. Unfortunately, the use of SMEs as the primary source of CBT development personnel tends to reinforce this. As long as the Air Force experiences a lack

of qualified personnel, it will continue to underutilize CBT's capabilities. In the meantime, there is a real need for guidance to aid in selecting the most appropriate CBT system for a given application and applying the most effective and efficient instructional design, development and delivery strategies. Whether this guidance takes the form of a desktop reference, additional training, or an automated expert system remains a subject for further research.

CBT Development Procedures

CBT development cannot be efficient without systematic planning and management. Inexperienced management and development personnel compound the problem. There were frequent delays in storyboards (35.1%) and production of lessons on-line (44.4%). Most delays were due to the need for revisions of various types, including revising the objectives (17.6%). The need to revise objectives while validating a course will delay the development process and may result from the inexperience of the personnel developing the objectives. Air Force organizations planning to develop CBT should make it a point to become familiar with the CBT courses available, guidance systems being transitioned from R+D and DoD and Air Force regulations governing the use of CBT an other interactive technologies.

Standardization of CBT Systems and Procedures

There are two standardization issues: 1) the standardization of hardware, software and authoring systems, and 2) the standardization of lesson development procedures and practices. Standardization of CBT systems is rare. Over half of the CBT systems are networked (58.4%), while the others are stand-alone applications. Various authoring systems are being used throughout the Air Force. CBT hardware and software selection seems to be based on the characteristics of each other rather than on a specification of training system requirements.[37]

Standardization of lesson development is critical to the production of quality CBT. Current Air Force CBT development practices vary. In spite of using format guides (77.3%), sample lessons (52.1%), flowcharts (77%) and storyboards (83.2%), significant revisions are made when lessons are already on-line (55.1%). Air Force development teams appear to be following standardized procedures, but they may not know the real purpose for using these standardization tools. A contributing factor may be the inexperience of development personnel. Improved guidance, training and stability of the development team should contribute to better courseware development practices.

Problem Causes

Data concerning these issues have been presented throughout this report. The problems have various causes that stem from lack of clear and useable guidance at the basic level. Specifically, respondents felt that there is no Air Force implementation policy for CBT from the

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[37] Software requirements were considered by 72.3% of respondents in selecting hardware, and hardware requirements were considered by 67.7% of respondents in selecting software. Compare these figures to the 50.6% of respondents who considered training requirements when selecting hardware, and 36.6% when selecting software.

highest levels of command down through the various major commands to the organizations implementing CBT. This is particularly true for CBT planning, which most organizations fail to do well. While most organizations attempt to plan, few accomplish all the required activities. Organizations tend to omit steps in the planning process out of ignorance that an activity should be performed, rather than as the result of some conscious effort to do it their own way. Procedures followed in one organization are not necessarily the same as those followed by another organization. In many instances commands and organizations develop their own policy and guidance for CBT. While AFP 50-58 provides excellent guidance to all organizations developing training, individual organizations can tailor the procedures to fit their unique requirements. The same kind of guidance provided in AFP 50-58 needs to be developed for Air Force CBT.

Another contributing cause of many of the Air Force's CBT problems is lack of experienced or trained managers and CBT developers. Survey results indicate that a majority of Air Force development team members and a significant portion of the management are inexperienced and that personnel problems affect CBT development. In most cases, the short-term solution to these problems is to provide as much training as possible to the various team members, especially the project manager. In the long run, tracking experienced CBT personnel will help alleviate this problem.

Finally, as with most other training problems, *an ounce of analysis is worth a pound of development.* Most reported problems result from a failure to properly plan for various CBT activities. Most organizations make attempts to plan for CBT but are unaware of what planning activities need to be performed or how to perform them. Guidance for CBT planning and application is urgently needed.

Recommendations

While the findings from this survey are not conclusive, they are indicative that Air Force CBT is in need of improvement. Three specific courses of action to improve CBT are recommended based on the findings of this survey:

- Further research is needed on the *quality* of Air Force CBT.
- Specific guidance and training are needed for managers and developers of CBT.
- Air Force personnel capable of developing CBT need to be identified for future assignments.

Further Research into CBT Quality

This survey did not examine the quality of Air Force CBT. Instead, it focused on issues related to CBT planning, selection and implementation. Students were not surveyed, nor was courseware evaluated. In spite of this, wherever the researchers went they were asked to look at examples of CBT. Many sites felt that they were producing *the best courseware in the Air Force.* Their confidence may be based on appearance rather than effectiveness. This survey indicates that few respondents (28.9%) attempted to validate their courseware with on-the-job performance, and fewer (18.4%) sought supervisors' evaluations of the product. Further

research is needed to determine the quality of Air Force CBT, i.e., its effectiveness and efficiency as a training medium.

Guidance and Training for CBT Managers and Developers

Data from this survey suggest several problems associated with CBT development. They range from improper planning for CBT to reluctance on the part of instructors to accept CBT. Both CBT managers and developers need guidance to follow in planning, selecting and implementing the medium. This guidance can take the form of procedural manuals, models, or automated expert systems that assist personnel in accomplishing some aspect of CBT. Those involved in CBT should receive clear guidance and training in several areas, including the steps to follow in developing CBT, the rationale for each step, how to perform each step and the typical problems which might be encountered. The training should provide the students with the opportunity to practice those skills before being asked to use them on the job.

Identification of Air Force CBT Personnel

If the Air Force intends to remain in the *CBT business*, a final recommendation to improve Air Force CBT is to provide a means within the personnel system to identify personnel with CBT skills for future assignment. Personnel turnover and the lack of qualified replacements are two of the major contributing factors to problems in CBT. If qualified CBT personnel could be identified for reassignment to positions in which their CBT skills could be utilized it might produce a stabilizing effect on projects where turnover averages 26.6% and approximately 47.4% of the development team is experienced. If assignment policies do not permit such identification and utilization of Air Force personnel with CBT experience, then the Air Force may wish to consider limiting CBT projects to specific organizations or to development by contractor .

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APPENDIX

Note: Numbers beside questionnaire responses indicate the number of survey participants selecting the response. In some cases, numbers may add up to more or less than the total expected. This is usually because a participant skipped the item, because more than one item could be checked, or because the question only appeared on one version of the survey.

CBT PERSONNEL PROFILE QUESTIONNAIRE

The purpose of this questionnaire is to identify Air Force personnel who have had experience in some aspect of Computer-Based Training (CBT) in an Air Force environment. Please complete this form as quickly and completely as possible and return it to _____ by _____.

Please identify yourself.

Name/Rank: _____

Position and Job Title: _____

Base: _____

Organization: _____

Office Symbol: _____ Phone: _____

Please describe your CBT experience. Indicate the extent of your involvement for all appropriate items. Explain "Other" in full.

POSITION	TIME IN MONTHS
Current/past manager of CBT program	_____
Current/past developer of CBT courseware	_____
Current/past instructor in CBT course	_____
Current/past CBT contract monitor	_____
Staff computer systems expert involved in CBT	_____
Other: _____	_____

Please name the CBT systems with which you have been associated. If possible, specify operating systems, hardware, and software, as well as the relevant courseware.

_____

_____

_____

_____

U. S. Air Force
Human Resources Laboratory
Computer-Based Training (CBT)
Survey

PURPOSE:

The *U.S. Air Force Human Resources Laboratory (AFHRL)*, in conjunction with their support contractor *Mei Associates, Inc.*, is conducting a survey of Computer-Based Training (CBT) in the Air Force. The ultimate goal of this instrument is to identify problems associated with CBT and the approach which various Air Force training organizations have taken to solve these problems.

YOUR INVOLVEMENT:

Your organization has agreed to participate in the CBT Survey. You will be expected to answer the questions in this questionnaire to the best of your ability. Once you have completed the questionnaire, you should notify the individual within your command who has been designated as the point of contact (POC). The POC will collect all survey materials and notify AFHRL. You may also be scheduled for a follow up interview after the questionnaire has been analyzed. During this brief interview you will be asked about some of the specific answers that you have given in the questionnaire.

[Please complete the following items regarding your name and position.]

Name:_____

Rank:_____

Organization:_____

Organization Code:_____ **Phone:**_____

CBT SURVEY

Instructions: Indicate your responses to the questions by circling the answer in the case of Yes/No questions, filling in the blank provided or by marking one or more of the options presented in the multiple choice type questions. Please note that on most of the multiple choice questions, you may select one or more options.

The questions in this survey ask about the various activities associated with CBT planning, selection, development, validation, implementation, and maintenance. If you have participated in more than one CBT project, please answer these questions on the basis of what was usually done, rather than on what was done for particular projects.

If you encounter any questions that are ambiguous or not understood, please make a note of this in the margin adjacent to the question affected so that we may discuss these with you during the interview process.

As you complete this survey, keep in mind that THERE ARE NO RIGHT OR WRONG ANSWERS to these questions. No evaluation will be made about you, your work, or this training center based on the answers you provide. Each of your responses are meaningful and will further understanding of CBT planning, selection and implementation issues. We sincerely appreciate your cooperation.

A. ***Planning.*** *Generally, planning for CBT involves the identification and analysis of training requirements (e.g., training needs analysis, or job or task analysis), and the definition of training development guidelines, allocation of resources, and system selection (including analysis of user characteristics, media selection, and other facilities analysis).*

1. Have you been involved in planning for the development and/or implementation of CBT?

192 53
Yes No

(If 1 = No, please go on to Section B, Question 47.)

2. If 1 = Yes, what was the nature of your involvement? (Check the appropriate response/s.)

83 Program Manager
24 Contract Manager
123 Instructional Developer
43 Instructor (End-user)
89 Subject Matter Expert
47 Other: _____

3. Have you been involved in the analysis phase of planning, i.e., identification of training requirements, job or task analysis, characterization of target student population, media analysis, etc.?

145 47
Yes No

(If 3 = No, please go on to Question 28.)

4. If 3 = Yes, was a formal training needs assessment performed in the planning phase of CBT?

111 32
Yes No

5. If 4 = No, why not? (Check the appropriate response/s.)

7 There wasn't enough time.
2 There were not enough funds.
8 Personnel were not available to conduct the analysis.
2 Personnel (subject matter experts, instructional experts, etc.) were not available to provide the data necessary to complete the analysis.
19 Training needs were derived from current course material.
2 The training needs assessment completed previously was current.
9 Other: _____

6. If 4 = Yes, was the training needs assessment used to identify training requirements?

104 Yes 8 No

7. If 6 = No, why not? (Check the appropriate response/s.)

2 The analysis was incomplete.
1 The analysis was not accepted as valid.
0 The analysis contained out-of-date information.
4 Other: _____

8. If 6 = No, how were the training requirements identified?

1 Developed from existing course objectives.
2 Developed from existing course materials and/or manuals.
2 Training requirements identified previously were current and, subsequently, used for the CBT project.
0 Other: _____

9. Was a formal job/task analysis performed as part of the CBT planning process?

96 Yes 47 No

10. If **9** = No, why not? (Check the appropriate response/s.)

6 There wasn't enough time.
2 There were not enough funds.
9 Personnel were not available to conduct the analysis.
3 Personnel (subject matter experts, etc.) were not available to provide the data necessary to complete the analysis.
26 Jobs and tasks were derived from current course material and/or manuals.
15 The job/task analysis completed previously was current.
11 Other: _____

11. If **9** = Yes, were the job/task analysis results available for use by the instructional designers during the development phase of the project?

87 Yes 8 No

12. If **11** = No, why not? (Check the appropriate response/s.)

4 The analysis was incomplete.
1 The analysis was not accepted as valid.
0 The analysis contained out-of-date information.
3 Other: _____

13. If **11** = Yes, were these results used by the instructional designers?

66 Yes 5 No

14. Did the characteristics of the prospective students, such as reading level, prerequisite skills, etc., play a role in the planning or front-end analysis of the project?

118 Yes 24 No

15. If 14 = No, why not? (Check the appropriate response/s.)

__1__ There wasn't enough time.
__2__ There were not enough funds.
__4__ Personnel were not available to conduct the analysis.
__4__ Personnel (subject matter experts, students etc.) were not available to provide the data necessary to complete the analysis.
__13__ Other: _____

16. If 14 = Yes, was this information (student characterization) used to determine training modes (tutorial, practice, simulation, etc.)?

98 Yes 19 No

17. If 16 = No, why not? (Check the appropriate response/s.)

__1__ The analysis was incomplete.
__1__ The analysis was not accepted as valid.
__0__ The analysis contained out-of-date information.
__15__ Training mode was pre-determined.
__4__ Other: _____

18. Were facility requirements (HVAC needs, room size, layout, anti-static floor covering, etc.) assessed in the planning phase?

91 Yes 52 No

19. If 18 = No, why not? (Check the appropriate response/s.)

__5__ There wasn't enough time.
__5__ There were not enough funds.
__7__ Personnel were not available to conduct the planning.
__6__ Personnel (systems experts, electrician, fire marshall, etc.) were not available to provide the data necessary to complete the planning.
__39__ Other: _____

20. If 18 = Yes, were facilites requirements used to select or prepare the training site for the CBT system?

70 Yes 21 No

21. If 20 = No, why not? (Check the appropriate response/s.)

__1__ The plan was incomplete.
__1__ The plan was not accepted.
__1__ The plan called for facilities which were not available.
__0__ The plan was based on out-of-date information.
__15__ Other: _____

22. Was a media analysis performed in the planning phase of the CBT project?

70 Yes 70 No

23. If 22 = No, why not? (Check the appropriate response/s.)

__2__ There wasn't enough time.
__2__ There were not enough funds.
__5__ Personnel were not available to conduct the analysis.
__3__ Personnel (subject matter experts, etc.) were not available to provide the data necessary to complete the planning.
__54__ Media had been predetermined by a higher authority.
__20__ Other: _____

24. If 22 = Yes, what method or tool was used to conduct the analysis? (Check the appropriate response/s.)

__48__ SME expertise
__31__ Paper-based media selection model
__12__ Automated media selection model
__15__ Other: _____

25. Were training objectives developed for the computer-based instruction?

126 Yes 19 No

26. If **25** = **No**, why not? (Check the appropriate response/s.)

__0__ There wasn't enough time.
__0__ There weren't enough funds.
__2__ Personnel were not available to develop the objectives.
__14__ Previously developed objectives were used.
__1__ Training objectives were not required.
__3__ Other: _____

27. If **25** = **Yes**, how were the objectives developed? (Check the appropriate response/s.)

__88__ From the job/task analysis
__15__ From the media analysis
__59__ From Tech Orders or manuals
__50__ By modifying previously written objectives
__86__ Using SME expertise
__16__ To utilize equipment purchased or expected
__68__ To meet training requirements
__7__ Other: _____

28. Have you been involved in budgeting for CBT systems?

85 Yes 100 No

(If **28** = **No**, please go on to Question 34.)

29. If **28** = **Yes**, what was your role? (Check the appropriate response/s.)

__68__ Provided input for hardware acquisition
__74__ Provided input for software acquisition
__26__ Provided input for facilities acquisition
__60__ Provided input regarding personnel requirements
__71__ Provided input regarding project completion time
__55__ Provided input regarding training requirements of the project team
__39__ Conducted cost/benefits analyses
__29__ Developed the budget
__10__ Other: _____

30. Did the budget, as developed, accurately anticipate actual costs?

39 Yes 38 No

31. If 30 = No, why not? (Check the appropriate response/s.)

6 Hardware cost more than expected.
6 Software cost more than expected.
13 It became necessary to purchase additional hardware.
11 It became necessary to purchase additional software.
5 Hardware maintenance was not factored in.
7 Software maintenance was not factored in.
6 The cost of training of project team members was not factored in.
16 Additional training was required due to team member turnover.
9 Production delays occurred while team members learned to use the system.
21 Development took longer than expected.
11 The review process took longer than expected.
12 Revisions caused unexpected production delays.
14 Training requirements changed, causing courseware revisions.
14 Other: _____

32. Did funding shortfalls cause deviations from the project development plan?

39 Yes 42 No

33. If 32 = Yes, what was the result? (Check the appropriate response/s.)

15 The scope of the project (i.e., the number of lessons) was reduced.
3 The length of individual lessons was reduced.
9 The interactivity within lessons was reduced.
10 The number of graphics was reduced.
17 Less hardware was purchased.
10 Less expensive hardware was purchased.
11 Less software was purchased.
7 Less expensive software was purchased.
12 The project was put on hold until funding became available.
8 Other: _____

34. Have you been involved in the development of a CBT Statement of Work (SOW)?

55 Yes 130 No

(If 34 = No, please go on to Section B, Question 47.)

35. If 34 = Yes, what was your role? (Check the appropriate response/s.)

35 Provided input regarding the scope of the project
33 Provided input regarding hardware
35 Provided input regarding software
36 Provided input regarding the deliverable schedule
35 Provided input regarding the deliverable specifications
41 Provided input regarding the review process
36 Provided input regarding acceptance test procedures
17 Wrote the SOW
10 Other: _____

36. Was the SOW comprehensive with respect to the project scope (number and length of lessons, level of instruction, level of interactivity, etc.)?

42 Yes 10 No

37. What was included in the description of the scope of the project? (Check the appropriate response/s.)

38 Number of lessons
23 Length of lessons
36 Level of instruction (initial vs. advanced)
23 Level of interactivity (e.g., x times/3 minutes)
29 Testing requirements
25 Validation plan
23 Validation criteria
4 Other _____

38. Did the SOW provide a schedule for deliverables?

44 Yes 7 No

39. If 38 = Yes, were these deliverable dates achieved?

19 Yes 24 No

40. If 38 = No, why not? (Check the appropriate response/s.)

7 Production delays occurred while team members learned to use the system.
19 Development took longer than expected.
9 The review process took longer than expected.
11 Revisions caused unexpected production delays.
8 Training requirements changed, causing courseware revisions.
3 Funding shortfalls caused unexpected delays.
16 Other: _____

41. Were data specification documents (DIDs) required by the SOW?

34 Yes 12 No

42. If 41 = Yes, were these documents provided to the developers?

29 Yes 4 No

43. If 42 = No, why not? (Check the appropriate response/s.)

0 The specs were out-of-date.
0 The specs were not relevant to the project.
2 The developer was expected to obtain them.
4 Other: _____

44. Was the review process described in the SOW?

40 Yes 10 No

45. If 44 = Yes, was this process followed during development?

32 Yes 9 No

46. If 45 = No, why not? (Check the appropriate response/s.)

1 Development delays reduced review time available.
2 Reviewers' other duties prevented thorough review.
3 Personnel turnover altered the review process.
3 The process was modified to reflect changing project requirements.
4 The process did not work as described.
6 Other: _____

B. ***Selection.*** *The selection process involves the determination of appropriate hardware and software given training needs.*

47. Have you been involved in the selection of a CBT system (hardware and software)?

109 Yes 135 No

(If **47** = No, please go on to Section C, Question 56.)

48. If **47** = Yes, what was the nature of your involvement? (Please check the appropriate response/s.)

58 Program Manager
13 Contract Manager
57 Instructional Developer
22 Instructor (End-user)
38 Subject Matter Expert
34 Programmer
16 Graphic Artist
24 Other: _____

49. Have you been involved in the selection of CBT hardware?

83 Yes 25 No

50. If **49** = Yes, who, including yourself, selected the hardware? (Check the appropriate response/s.)

20 End-users (instructors)
43 Systems experts
35 Courseware developers
54 Higher authorities
23 Contractor
10 Other: _____

51. If **49 = Yes**, which of the following were used to determine hardware requirements? (Check the appropriate response/s.)

42 Training requirements analysis
28 Student characteristics (human factors analysis)
22 Class size
60 Software requirements (authoring language/system, graphics software, etc.)
26 Training site
31 End-user/instructor input
16 System administrator input
30 Other: _____

52. Have you been involved in the selection of CBT software (authoring language/system, graphics software, programming language, etc.)?

93 Yes 18 No

53. If **52 = Yes**, who, including yourself, selected the software? (Check the appropriate response/s.)

21 End-users (instructors)
31 Systems experts
51 Courseware developers
60 Higher authorities
17 Contractor
13 Other: _____

54. If **52 = Yes**, which of the following were used to determine software requirements? (Check the appropriate response/s.)

34 Training requirements analysis
21 Student characteristics (human factors analysis)
50 CMI reporting requirements
70 Presentation (fonts, graphics, colors, etc.) capabilities
63 Hardware requirements
73 Ease of use
34 End-user/instructor input
22 System administrator input
55 Developer input
22 Other: _____

55. What type of authoring software was used to program the courseware? (Check the appropriate response/s.)

__16__ Programming language
__51__ Authoring language
__63__ Authoring system
__9__ Other: _____

C. ***Development.*** *This stage involves the design, production, and initial review and revision of courseware.*

56. Have you been involved in the development of CBT?

211 Yes 33 No

(If **56** = No, please go on to Section D, Question 158.)

57. If **56** = Yes, what was the nature of your involvement? (Check the appropriate response/s.)

84 Program Manager
17 Contract Manager
146 Instructional Developer
51 Instructor (End-user)
117 Subject Matter Expert
84 Programmer
66 Graphic Artist
37 Other: _____

58. Who comprised the development team? (Check the appropriate response/s.)

106 Program Manager
21 Contract Manager
141 Instructional Developer
72 Course Instructor
142 Subject Matter Expert
102 Programmer
86 Graphic Artist
25 Contract Development Team
34 Other: _____

59. Were each of the team members aware of his/her role and responsibilities on the project?

133 Yes 38 No

60. If **59** = No, why were the tasks unclear? (Check the appropriate response/s.)

__12__ Turnover of development team was high.
__20__ Roles and responsibilities changed frequently.
__29__ Team member(s) wore more than "one hat."
__11__ Team member(s) were never informed about roles and duties.
__17__ No one seemed to know who was responsible for what.
__2__ This was not important to project completion.
__11__ Other: _____

61. Did a formal chain of authority exist within the CBT project team?

132 Yes 36 No

62. If **61** = Yes, was this hierarchy followed during the design, development, review and revision processes?

116 Yes 13 No

63. Were the activities of each team member well coordinated throughout the project?

121 Yes 42 No

64. Was communication between each of the team members clear and effective?

119 Yes 45 No

65. Were each of the CBT team members experienced in CBT design and development?

37 Yes 133 No

66. If **65 = No**, why weren't individuals with CBT instructional expertise selected for the team? (Check the appropriate response/s.)

39 They did not have background in subject matter.
20 They were working on other projects.
74 They were not available.
17 Experienced developers were not required.
48 Other: _____

67. If **65 = No**, which team member(s) did not have experience designing and developing computer-based instruction? (Check the appropriate response/s.)

51 Program Manager
13 Contract Manager
80 Instructional Developer
46 Course Instructor
82 Subject Matter Expert
52 Programmer
39 Graphic Artist
6 Contractor Development Team
19 Other: _____

68. Did each member of the development team receive training in CBT instructional design strategies?

88 Yes 82 No

69. If **68 = No**, why was this training not provided? (Check the appropriate response/s.)

11 Training was not budgeted.
31 There was no time for training.
29 No instructional design training was available.
30 Training was not deemed necessary due to the background and experience of the development staff.
19 Other: _____

70. If 68 = No, who did NOT receive instructional design training? (Check the appropriate response/s.)

__25__ Program Manager
__5__ Contract Manager
__42__ Instructional Developer
__36__ Course Instructor
__53__ Subject Matter Expert
__29__ Programmer
__26__ Graphic Artist
__2__ Contractor Development Team
__11__ Other: _____

71. If 68 = Yes, what material did the training cover? (Check the appropriate response/s.)

__69__ Tutorial strategies
__61__ Remediation strategies
__76__ Question development
__76__ Feedback/prompt development
__71__ Types of interactivity
__14__ Other: _____

72. Was the CBT developed in-house?

178 29
Yes No

73. If 72 = No, why not? (Check the appropriate response/s.)

__10__ Qualified instructional developers were not available.
__2__ It was not possible to train instructional developers to use the selected system.
__1__ Qualified SMEs were not available.
__7__ Qualified programmers were not available.
__17__ It was more cost effective to contract development.
__14__ Other: _____

74. Were course instructors involved in the development of the CBT?

140 66
Yes No

75. If 74 = No, why not?

__22 They were not available.
__14 They were not qualified instructional designers.
__17 They lacked experience in CBT design and development.
__17 Other: _____

76. If 74 = Yes, what was their role? (Check the appropriate response/s.)

__70 Wrote lessons
__91 Provided objectives input
_120 Provided content input
__52 Provided input regarding student characteristics
__60 Provided input regarding screen design
__71 Provided input regarding lesson structure (attention, motivation, etc.)
_103 Reviewed lesson specification documents, storyboards, etc. for accuracy
_110 Reviewed on-line lessons for accuracy
__86 Provided quality control
__14 Other: _____

77. Were subject matter experts (SMEs) involved in the development of the CBT?

196 Yes 11 No

78. If 77 = Yes, what was their role? (Check the appropriate response/s.)

_121 Wrote lessons
_131 Provided objectives input
_180 Provided content input
_147 Reviewed lesson specification documents, storyboards, etc. for accuracy
_160 Reviewed on-line lessons for accuracy
__24 Other: _____

79. If 77 = No, what resource(s) were used to ensure content accuracy? (Check the appropriate response/s.)

___9 Technical orders or manuals
___5 Regulations
__11 Existing course materials
___3 Commercially available texts
___3 Other: _____

80. Did the development staff coordinate their input to the lesson content and structure?

179 Yes 20 No

81. If 80 = No, why not? (Check the appropriate response/s.)

___4 Coordination was not required by the SOW.
___2 Distance made coordination difficult.
___5 Team members worked for different agencies.
___8 The developers were expected to utilize input from many sources.
___9 Other: _____

82. If 80 = Yes, how was the coordination accomplished? (Check the appropriate response/s.)

_153 Face-to-face meetings were held.
__47 All input was routed through a single higher authority.
__49 Tasks were divided between development staff.
__51 A set of written procedures was followed.
__17 Other: _____

83. Were programmers used to author the courseware?

99 Yes 104 No

84. If **83** = Yes, what was their role? (Check the appropriate response/s.)

__41__ Wrote the CBT
__42__ Assisted with system operation
__41__ Trained developers in system use
__58__ Provided input regarding authoring capabilities
__38__ Provided input regarding the computer managed instruction (CMI)
__49__ Provided input regarding graphics development
__71__ Programmed CBT
__48__ Programmed CMI functions
__8__ Other: _____

85. Was a contractor used?

80 Yes 124 No

86. If **85** = Yes, what was the contractor's role? (Check the appropriate response/s.)

__35__ Provide instructional developers
__19__ Provide subject matter expertise
__47__ Provide programming services
__30__ Provide developer training
__53__ Develop courseware
__19__ Validate courseware
__36__ Install equipment
__35__ Install software
__10__ Other: _____

87. If **86** = Yes, did the contractor maintain an on-site presence?

45 Yes 32 No

88. If 87 = Yes, what did the contractor do on-site? (Check the appropriate response/s.)

__15 Facilitate communication between the contractor and client
__15 Collect data
__22 Develop courseware
__23 Install hardware
__25 Support/maintain hardware
__22 Install software
__27 Support/maintain software
__18 Provide training
___9 Conduct validation
___8 Model courseware use
___5 Other: _____

89. Were development personnel lost (due to turnover) during the development stage?

136 Yes
67 No

90. If 89 = Yes, what percentage? _____%

Mean = 41.4%
Median = 40%
Mode = 50%

91. If 89 = Yes, why did personnel turnover occur?

__48 Transferred to another project
__72 PCS'd to another station
__49 Left the Air Force
__17 Other: _____

92. If 89 = Yes, what were the typical results? (Check the appropriate response/s.)

__98 Development time increased
__16 Development time decreased
__26 Courseware design requirements changed
__26 Courseware scope changed
__77 Retraining was required
__35 Lesson quality decreased
__11 Lesson quality increased
__22 Other: _____

93. Were you involved in designing CBT? (This stage involves the development of format or design specifications and sample lessons.)

161 Yes 44 No

94. If 93 = Yes, what was your role? (Check the appropriate response/s.)

60 Program Manager
9 Contract Manager
114 Instructional Developer
38 Instructor (End-user)
74 Subject Matter Expert
61 Programmer
87 Graphic Artist
17 Other: _____

95. Was a format or style guide used?

150 Yes 44 No

96. If 95 = Yes, what was covered in the guide? (Check the appropriate response/s.)

86 Course structure
116 Lesson structure
97 Objectives use
115 Titles
123 Menus
124 Questions
130 Feedback
121 Branching
55 Regulations
82 Language standards
101 Testing
14 Other: _____

33 Enrichment
81 Review
133 Screen Design
131 Color
106 Spacing
47 Content enhancements (e.g., advance organizers)
77 Icons
104 Graphics
63 CMI

97. If 95 = Yes, how was the guide developed? (Check the appropriate response/s.)

114 It was developed in-house.
15 It was developed by a contractor.
51 It was developed through trial and error.
34 An existing guide was modified.
13 Other: _____

98. Were sample lesson/s developed to guide the design process?

101 Yes 93 No

99. If 98 = Yes, what guided the development of these sample lesson/s? (Check the appropriate response/s.)

16 SOW
14 Regulations
48 Format/style guide
60 Lesson objectives
10 Commercially available texts
26 Manuals and/or tech orders
72 Authoring software capabilities
29 Other lessons
29 Templates (boilerplates)
14 Other: _____

100. If 98 = Yes, were the sample lessons accepted as models for future lesson development?

87 Yes 16 No

101. If 100 = No, why not? (Check the appropriate response/s.)

3 Requirements (SOW, regulations, etc.) were not met.
4 Design standards (format/style guide, templates, etc.) were not followed.
2 Lesson content was inaccurate.
8 Requirements changed.
8 Design standards changed.
10 Other: _____

102. Were flow charts developed to illustrate lesson progression?

154 Yes 46 No

103. If **102** = Yes, were the flow charts accepted as guides for future lesson development?

131 Yes 20 No

104. If **103** = No, why not? (Check the appropriate response/s.)

0 Requirements (SOW, regulations, etc.) were not met.
5 Design standards (format/style guide, templates, etc.) were not reflected in the charts.
0 Chart sequence was inaccurate.
9 Requirements changed.
7 Design standards changed.
12 Other: _____

105. Were storyboards developed for the CBT lessons?

164 Yes 33 No

106. If **105** = Yes, what guided storyboard development? (Check the appropriate response/s.)

20 SOW
30 Regulations
96 Format/style guide
96 Lesson objectives
14 Commercially available texts
42 Manuals and/or tech orders
65 Software capabilities
46 Current traditional lessons
38 Sample lessons
30 Templates (boilerplates)
20 Other: _____

107. If **105** = Yes, were the storyboards reviewed by SMEs and/or instructors for acceptability?

151 Yes 13 No

108. If **107** = No, why not? (Check the appropriate response/s.)

__1__ Review was not required by the SOW.
__6__ There was not sufficient time for storyboard review.
__5__ Qualified SMEs and/or instructors were not available.
__2__ Storyboard review was not budgeted.
__8__ Other: _____

109. If **107** = Yes, were the reviewers trained in instructional design strategies?

71 46
Yes No

110. If **107** = Yes, were revisions usually required?

121 13
Yes No

111. If **110** = Yes, what was the general nature of these revisions? (Check the appropriate response/s.)

__25__ Objective development
__61__ Sequence of instruction
__91__ Content
__58__ Format
__91__ Grammatical/spelling/punctuation errors
__54__ Graphics
__56__ Interactivity
__33__ Advance organizers (titles, bolding, etc.)
__11__ Other: _____

112. Were records kept of changes made to lessons following review?

123 48 74
Yes No N/A

113. If storyboards were developed, were they used for on-line development?

148 11 86
Yes No N/A

114. If **113** = No, why not? (Check the appropriate response/s.)

__0__ Requirements (SOW, regulations, etc.) were not met.
__1__ Design standards (format/style guide, templates, etc.) were not reflected in the storyboards.
__1__ Content was inaccurate.
__0__ Training requirements changed.
__3__ Design standards changed.
__4__ Content requirements changed.
__0__ Required corrections were not made.
__4__ Other: _____

115. Were the storyboards completed on time?

100 54
Yes No

116. If **115** = No, why not? (Check the appropriate response/s.)

__24__ Personnel turnover caused delays.
__23__ The review process took longer than expected.
__32__ Revisions caused unexpected delays.
__11__ Training requirements changed, causing storyboard revisions.
__11__ Design standards changed.
__14__ Content requirements changed.
__16__ Other: _____

117. Were you involved in the on-line development of the CBT?

166 37
Yes No

(If **117** = No, please go on to Section D, Question 158.)

118. If **117** = Yes, what role did you play? (Check the appropriate response/s.)

__56__ Program Manager
__9__ Contract Manager
__120__ Instructional Developer
__40__ Instructor (End-user)
__26__ Other: _____
__81__ Subject Matter Expert
__74__ Programmer
__56__ Graphic Artist

119. Was authoring software training provided?

121	42
Yes	No

120. If 119 = Yes, what was covered in the training? (Check the appropriate response/s.)

- 116 Text entry/editing
- 116 Branching
- 96 Interactivity
- 106 Graphics
- 65 CMI
- 96 On-line documentation (menus, help screens, command/option lines)
- 59 Software structure
- 40 How to modify the software
- 13 Other: _____

121. If 119 = No, why not? (Check the appropriate response/s.)

- 7 Training was too expensive.
- 7 Time was not available.
- 6 Personnel were not available.
- 27 Programmers were expected to learn software on their own.
- 7 Programmers already knew the software.
- 12 Other: _____

122. Did you utilize the computer for CMI (data collection and student management) functions, as well as lesson delivery?

121	46
Yes	No

123. If 122 = Yes, what data was collected? (Check the appropriate response/s.)

- 111 Student data (name, job title, etc.)
- 112 Test scores
- 88 Time in lesson
- 78 Embedded question scores
- 58 Number of attempts per question
- 72 Answer analysis
- 13 Other: _____

124. If 122 = No, why not?

7 Authoring software did not provide CMI capability.
10 Data collection was not required.
7 Information collected by the CMI was not necessary.
10 Programmers were not trained to develop CMI.
7 The instructor was responsible for data collection.
17 Other: _____

125. Were questions (i.e., practice questions) embedded within lessons?

152 Yes
10 No

126. If 125 = Yes, did the types of embedded questions vary?

149 Yes
3 No

127. If 126 = Yes, what types of questions were used? (Check the appropriate response/s.)

130 True/false
144 Multiple choice
94 Fill-in
36 Constructed response
73 Areas of screen (move the cursor or touch a pointer to select an element on the screen.)
6 Verbal response
16 Other: _____

128. Was feedback for embedded questions available?

156 Yes
2 No

129. If 128 = Yes, what type of feedback was available? (Check the appropriate response/s.)

32	Implied (question is repeated when the student's answer is wrong)
44	Correct/incorrect only
132	Correct/incorrect with explanation/elaboration
73	Response-specific (feedback varies with student's answer)
88	Correct/incorrect with branching to remedial or advanced instruction
47	Response-specific with branching to remedial or advanced instruction
5	Other: _____

130. Were graphics developed?

160	8
Yes	No

131. If 130 = No, why not? (Check the appropriate response/s.)

5	Graphics were not required in the courseware.
1	Time did not permit the development of graphics.
2	Programmers were not trained to develop graphics.
1	Available graphic fidelity did not meet training requirements.
2	Other: _____

132. If 130 = Yes, what graphics were developed? (Check the appropriate response/s.)

86	Icons (graphic symbols used as advance organizers)
103	Charts
90	Tables
133	Diagrams
71	Maps
128	Equipment
88	Human figures
106	Animation
22	Other: _____

133. If **130 = Yes**, what were their characteristics? (Check the appropriate response/s.)

- 134 The graphics were useful.
- 136 The graphics added interest to the courseware.
- 105 The graphics were necessary to achieving the objective.
- 8 The graphics were inaccurate.
- 15 The graphics were too detailed.
- 11 The graphics did not contain enough detail.
- 11 The graphics were hard to read.

134. If graphics were developed, was the authoring software used?

Yes	No
114	39

135. If **134 = No**, why not? (Check the appropriate response/s.)

- 28 Another software package had more capabilities.
- 9 Another software package had more "clip art."
- 5 Another software package was more familiar to the programmers.
- 1 Other: _____

136. If **134 = Yes**, did the ease of development and the capabilities of the authoring software's graphics package meet the project's requirements?

Yes	No
67	29

137. Was audio included in the CBT?

Yes	No
81	87

138. If **137 = Yes**, what type of audio cues were developed? (Check the appropriate response/s.)

37 Rewards (bells, beeps, tunes)
25 Signals
21 Music
9 Engines
53 Verbalizations (commands, explanations, questions, etc.)
0 Songs
19 Other: _____

139. If **137 = No**, why not? (Check the appropriate response/s.)

46 Audio cues were not required in the courseware.
31 Audio fidelity was not available.
8 Time did not permit programming audio cues.
14 Programmers were not trained to develop audio cues.
19 Other: _____

140. Did the CBT utilize still or motion video images (i.e., interactive video)?

69 Yes 83 No

141. If **140 = Yes**, what was the video used to teach? (Check the appropriate responses/s.)

59 Identification (e.g., parts of an equipment panel, parts of the human body, etc.)
53 Procedures (e.g., equipment panel operation, use of a stethoscope)
22 Interpersonal skills (e.g., decision-making, crew coordination)
9 Communication skills (e.g., effective command issuance, foreign language)
8 Other: _____

142. If **140 = No**, why not? (Check the appropriate response/s.)

29 Video was not required in the courseware.
58 Video capability was not available.
12 Time did not permit programming video sequences.
17 Programmers were not trained to incorporate video sequences.
8 Other: _____

143. Was on-line help (T.O.'s, glossaries, lesson maps, etc.) developed to assist student progress through the lesson/s?

122 Yes 42 No

144. If 143 = No, why not? (Check the appropriate response/s.)

21 Such assistance was not required.
9 The authoring software did not support help screens.
0 The authoring software did not support menus.
2 The authoring software did not support command lines.
8 Programmers were not trained to develop on-line documentation.
8 Other: _____

145. If 143 = Yes, what type of help was offered? (Check the appropriate response/s.)

48 Tech Order (T.O.) or manual references
40 Diagrams
71 Glossaries
44 Lesson maps
39 Charts or tables
31 Sample forms
21 Other: _____

146. If 143 = Yes, how was the on-line help presented? (Check the appropriate response/s.)

70 Fixed menus (located at particular choice points)
29 "Pull-down" menus (accessed at the student's request)
60 Help screens (accessed at particular points, obscuring lesson content)
6 Adjustable help screens (accessed at the student's request, movable on the screen)
22 Extended help screens (accessed at the student's request, scrollable)
36 Fixed command lines (static throughout the lesson)
22 Modified command lines (reflecting student options as they change through the lesson)
16 Other _____

147. Was an on-line review conducted?

148 Yes 13 No

148. If **147** = No, why not? (Check the appropriate response/s.)

3 Review was not required by the SOW.
1 There was not sufficient time for on-line review.
0 Qualified SMEs and/or instructors were not available.
0 On-line review was not budgeted.
7 Other: _____

149. If **147** = Yes, who participated in the review? (Check the appropriate response/s.)

69 Program Manager
6 Contract Manager
81 Instructional Developer
64 Instructor (End-user)
88 Subject Matter Expert
48 Programmer
29 Graphic Artist
24 Other: _____

150. If **147** = Yes, were revisions required?

142	6
Yes	No

151. If **150** = Yes, what was the nature of the required revisions? (Check the appropriate response/s.)

25 Objective development
57 Sequence of instruction
99 Content
67 Format
117 Grammatical/spelling/punctuation errors
70 Graphics
54 Interactivity
30 Advance organizers (titles, bolding, etc.)
69 Branching
39 Menus
26 On-line documentation (help, command lines)
14 Other: _____

152. Was lesson production completed on time?

85 Yes 69 No

153. If 152 = No, why not? (Check the appropriate response/s.)

38 Personnel turnover caused delays.
26 Time to learn the system was not factored in to the schedule.
23 On-line review took longer than expected.
38 Revisions took longer than expected.
21 Training requirements changed.
16 Design requirements changed.
7 CMI requirements changed.
13 Equipment failures caused delays.
16 Software failures caused delays.
21 Other: _____

154. Were audit trail procedures used to track on-line development and revisions?

108 Yes 47 No

155. Did lesson development costs exceed the budget?

17 Yes 107 No

156. If 155 = Yes, by what percentage? _____

Mean = 45%
Median = 25%
Mode = 10%

157. If 155 is Yes, why? (Check the appropriate response/s.)

14 More time was required.
6 Additional personnel were required.
5 Additional hardware was required.
5 Additional software was required.
9 Personnel turnover occurred.
3 Hardware maintenance was necessary.
4 Software maintenance was necessary.
7 Training requirements changed.
6 Design requirements changed.
3 _____

D. *Validation. The purpose of validation is to determine whether or not the courseware teaches the objectives effectively.*

158. Have you been involved in the validation of CBT?

114 121
Yes No

(If **158** = No, please go on to Section E, Question 167.)

159. If **158** = Yes, what was the nature of your involvement? Check the appropriate response/s.

41 Program Manager
19 System Administrator
36 Instructor
15 Instructor Supervisor
54 Subject Matter Expert
29 Computer Systems Expert
27 Interviewer
26 Analyst
18 Other: _____

160. If **158** = Yes, what was the nature of the validation? (Check the appropriate response/s.)

73 Observation and survey/interview of instructors or SMEs taking individual lessons
81 Observation and survey/interview of individual students taking individual lessons
61 Observation and survey/interview of small groups of students taking individual lessons or groups of lessons
40 Observation and survey/interview of large groups (usually complete classes) of students taking the total course
33 Observation and analysis of the on-the-job performance of individuals who have taken the lesson/s
21 Supervisor evaluation of the on-the-job performance of individuals who have taken the lesson/s
12 Other: _____

161. Was a validation plan used?

77 35
Yes No

162. If **161** = Yes, what was covered by the plan? (Check the appropriate response/s.)

58 Procedures for student involvement
48 Procedures for instructor involvement
59 Data collection requirements
47 Procedures for data collection
32 Procedures for data analysis
36 Data reporting requirements
31 Procedures for reporting
43 Evaluation standards
6 Other: _____

163. If **161** = Yes, was the validation conducted according to the plan?

72 Yes 5 No

164. If **163** = No, why not? (Check the appropriate response/s.)

1 The plan's guidelines were not required by the SOW.
0 Regulations superseded the plan.
5 There was not enough time to follow the plan.
7 Necessary personnel were unavailable.
3 Students were not available.
5 Other: _____

165. Did the courseware validate?

94 Yes 7 No

166. If **165** = No, why not? (Check the appropriate response/s.)

4 Students failed to meet lesson objectives.
5 Key inaccuracies in content were discovered.
3 It was discovered that the courseware did not meet objective requirements.
1 Students were not able to apply instruction to the job (in the field).
4 Other: _____

E. *Implementation. This involves the actual use of CBT to provide required instruction to students.*

167. Have you been involved in the implementation of CBT?

137 98
Yes No

(If 167 = No, please go on to Section F, Question 206.)

168. If 167 = Yes, what was the nature of your involvement? (Check the appropriate response/s.)

54 Program Manager
34 System Administrator
43 Instructor
18 Instructor Supervisor
37 Computer Systems Expert
27 Other: _____

169. Where was your CBT courseware implemented? (Check the appropriate response/s.)

77 Formal training environment (i.e., schoolhouse)
45 Informal environment (e.g., during available time while on-the-job)
7 Other: _____

170. Was the CBT optional or required for students?

42 Optional
88 Required
4 Other: _____

171. Were you able to begin implementing CBT on time?

79 31
Yes No

172. If **171 = No**, why not? (Check the appropriate response/s.)

20 Development took longer than expected.
10 Courseware required more revisions than expected.
9 Hardware not available at training sites.
1 Software licenses not available at training sites.
12 Other: _____

173. Was a system administrator (person responsible for maintaining and troubleshooting hardware and authoring software) available to assist with system operation?

103	30
Yes	No

174. If **173 = Yes**, was training provided for the system administrator?

81	17
Yes	No

175. If **174 = Yes**, what was the administrator trained to do? (Check the appropriate response/s.)

46 Install hardware
65 Install software
42 Register instructors
60 Register students
58 Perform archival functions
65 Troubleshoot the system
14 Other: _____

176. If **173 = No**, who was responsible for the CBT system maintenance?

7 Program Manager
4 Instructor
9 Designer/Developer
8 Programmer
2 Computer Systems Expert
14 Other: _____

177. Were instructors available to assist students as they went through the CBT courseware?

82 Yes 20 No

(If **177** = No, go on to Question 190)

178. Were any instructors reluctant to teach using CBT?

67 Yes 37 No

179. If **178** = Yes, what reasons were given?

23 Concern about student management (individualization, varied completion times, etc.)
56 Lack of familiarity with the system
31 Concern about system reliability (answer judging, student advancement, etc.)
49 Concern about the effectiveness of the CBT
37 Concern about job security
44 Concern about instructor roles with CBT
11 Other: _____

180. Did instructors receive training on the system?

90 Yes 14 No

181. If **180** = Yes, what training was provided? (Check the appropriate response/s.)

7 Install hardware
24 Install software
21 Register instructors
50 Register students
16 Perform archival functions
18 Troubleshoot the system
42 Other: _____

182. If **180** = No, why not?

__7__ Training was not required.
__2__ Training was not available.
__1__ Training on the system was not budgeted for the instructors.
__2__ Other: _____

183. Did instructors receive training in CBT instructional techniques?

57 Yes 44 No

184. If **183** = No, why was no training offered for CBT instructors?

__18__ Training was not required.
__10__ Training was not available.
__7__ Training in CBT instructional techniques was not budgeted for instructors.
__7__ Other: _____

185. If **183** = Yes, what training was provided? (Check the appropriate response/s.)

__38__ Instructor roles with CBT
__50__ System operation (log on, log off, menu use, etc.)
__38__ Student data management (student registration, data collection, reports, etc.)
__33__ Course structure
__15__ Student time management
__31__ Integration of CBT with traditional instruction
__3__ Other: _____

186. What was the student-instructor ratio?

12 : 1 Mean
10 : 1 Median
8 : 1 Mode

187. Was the student-instructor ratio sufficient in most cases?

76 Yes 5 No

188. Was the instructor able to meet students' needs for assistance?

95 Yes 4 No

189. If 188 = No, why not? (Check the appropriate response/s.)

___2 The student-teacher ratio exceeded optimum limits.
___0 There was no opportunity for the instructor to interact with the students.
___3 There was not enough time for the instructor to fulfill students' requests for assistance.
___0 The instructor was not familiar with material covered in the request.
___1 The instructor was not familiar with the system elements being questioned.
___0 Other: _____

190. Were any students reluctant to use the CBT?

59 68
Yes No

191. If 190 = Yes, what reasons were given? (Check the appropriate response/s.)

44 Lack of familiarity with the system
28 Lack of keyboarding skills
12 Difficulty reading information presented on the computer screen
12 Concern about system reliability (answer judging, student advancement, etc.)
22 Other: _____

192. Did the software collect all required student data?

86 25 134
Yes No N/A

193. If 192 = No, what could not be collected? (Check the appropriate response/s.)

5 Student data (name, job title, etc.)
6 Test scores
7 Time in lesson
6 Embedded question scores
11 Number of attempts per question
14 Answer analysis
10 Other: _____

194. Did the software provide hard copy reports of the data collected?

94 15 136
Yes No N/A

195. Did the courseware meet perceived instructional needs?

107 Yes 16 No

196. If 195 = No, what reasons were given? (Check the appropriate response/s.)

4 Individualization disrupted the normal schedule.
3 Content was inaccurate.
0 Objectives were not met.
4 Objectives did not accurately meet training requirements.
5 Lessons were poorly presented.
3 Lessons were too difficult.
4 Lessons were too easy.
6 Lessons were too lengthy.
1 Lessons were incomplete.
1 Lesson sequence was confusing.
6 Other: _____

197. Did students "get lost" in the lesson/s?

29 Yes 98 No

198. If 197 = Yes, what reasons were given? (Check the appropriate response/s.)

10 Branching was confusing or didn't work.
6 Menus were confusing or didn't work.
1 Titles (and subtitles) were confusing.
9 There were too many layers or levels in the lesson.
8 Function key or command line options did not return the student to the lesson where he had left it.
5 Instruction required that the student refer to other documents or parts of the lesson, resulting in confusion.
7 Other: _____

199. Did students advance through the lessons as planned?

120 Yes 9 No

200. If **199** = No, why not? (Check the appropriate response/s.)

2 Students found ways to force the system to allow them to advance.
3 Test scores were inaccurately recorded.
2 Branching did not work properly.
4 Students got caught in an "endless loop."
2 Other: _____

201. Did the students use the on-line help (menus, command lines, glossaries, etc.)?

95 Yes 24 No

202. If **201** = No, what reasons were given? (Check the appropriate response/s.)

6 The courseware taught the material well enough.
1 The help was difficult to access.
10 Students preferred to get assistance from the instructor.
11 Other: _____

203. Were directions supplied to assist the student in answering the questions?

124 Yes 5 No

204. Were students able to follow the directions?

120 Yes 4 No

205. If **204** = No, why not? (Check the appropriate response/s.)

0 Directions were inconsistent in wording.
1 Directions were not consistently given.
0 Directions were confusing.
2 Directions were too lengthy.
2 Directions were incomplete.
2 Other: _____

F. Maintenance. This relates to maintaining and troubleshooting hardware and authoring software.

206. Have you been involved in the maintenance of CBT?

92 Yes 102 No

(If 206 = No, please go to Section G.)

207. If 206 = Yes, what was the nature of your involvement? (Check the appropriate response/s.)

45 Maintaining hardware
52 Mainting authoring software
32 Other: _____

208. Was the system hardware shared in any way (i.e., was a networked system used)?

52 Yes 37 No

(If 208 = No, please go to Question 213.)

209. Did the student load exceed the system's capabilities?

21 Yes 56 No

210. If 209 = Yes, what was the solution? (Check the appropriate response/s.)

7 Reschedule classes
3 Reschedule individual students
5 Require that students "double up"
6 Purchase and install additional student stations
10 Other: _____

211. Did requirements to share the system exceed its capabilities?

19 Yes 55 No

212. If **211** = Yes, what was the nature of the problem? (Check the appropriate response/s.)

- 5 Not able to add more courseware
- 4 Not able to add more student stations
- 1 Not able to add applications software (word processing, databases, etc.)
- 4 Not enough memory
- 11 Not enough speed
- 5 Not enough storage
- 4 Other: _____

213. Did you experience any hardware failures?

82	29
Yes	No

214. If **213** = Yes, what happened? (Check the appropriate response/s.)

- 44 A single station failed.
- 42 Multiple stations failed.
- 36 Data was lost.
- 26 Data was contaminated.
- 34 The system would not start up.
- 17 Other: _____

215. Were hardware maintenance contracts purchased?

73	32
Yes	No

216. If **215** = Yes, were the contracts utilized?

61	13
Yes	No

217. If **216** = Yes, what was the nature of the problem? (Check the appropriate response/s.)

- 40 System failure
- 12 System expansion desired
- 25 "Bugs" discovered in the system
- 18 Other: _____

218. Did you experience any problems with the authoring software?

51 45

Yes No

219. If **218 = Yes**, what types of problems occurred? (Check the appropriate response/s.)

__10__ Function keys did not work.
__10__ Menus did not work.
__15__ Commands (review, return, etc.) did not work.
__12__ Branching failed.
__13__ Graphics "bled" into text or other graphics.
__31__ Lessons "hung up".
__20__ Other: _____

220. Were authoring software maintenance contracts purchased?

40 61

Yes No

221. Was the software manufacturer's support used?

83 28

Yes No

222. If **221 = Yes**, was the manufacturer responsive in meeting the needs of the development staff?

52 9

Yes No

223. If **221 = No**, why not? (Check the appropriate response/s.)

__13__ Support was not needed.
__4__ Support was unavailable.
__6__ Required procedures for obtaining support were time-consuming.
__4__ A support contract was not obtained.
__5__ Other: _____

224. Was the software documentation used?

97 14

Yes No

225. If 224 = Yes, was the software documentation sufficient to meet the needs of the development team?

53 Yes 19 No

226. If 224 = No, why not? (Check the appropriate response/s.)

4 The documentation was not available.
9 The documentation was incomplete.
8 The documentation was inaccurate.
3 The documentation was out-of-date.
1 The documentation was not indexed properly.
1 Software training covered the documentation.
9 Other: _____

G. ***DISCUSSION.*** *The purpose of this section is to provide you with the opportunity to suggest areas of concern or interest which were not addressed in this questionnaire. Please note your comments or questions below. Thank you for your time.*